JOURNAL

VOLUME 9 NUMBER 8 • OCTOBER, 1953

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Skilled Bench Workers and Accurate Machine Work are Both Needed to Obtain Best Results in Making a Plastics Mold

(Photos courtesy of Newark Die Co.)

PUBLISHED BY THE SOCIETY OF PLASTICS ENGINEERS, INC.

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You Can Get Your Share without added Investment

YOU CAN STRIKE it rich in the flexible products market! It's new, big . . . growing *bigger!* And best of all, your present equipment can do the job. You don't spend a dollar extra on machinery! All you need is a change to VINYLITE Brand Plastic flexible molding compounds. These materials can be fabricated easily on standard molding machines.

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to almost any degree, from soft and rubbery to semi-rigid . . . withstand long flexing without cracking.

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in practically every shade . . . in transparent, opaque or translucent form with lustrous finish.

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non-fading, abrasion-resistant . . . deliver extra-long service.

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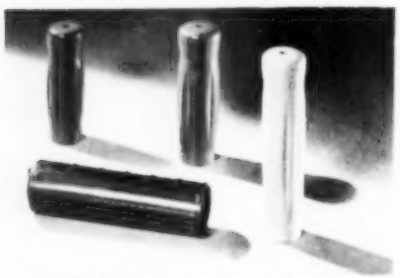
This brief summary of properties can only hint at what you could develop for *your* business through *flexible* production with VINYLITE Plastic flexible molding compounds. Get the full picture . . . complete technical information, present applications . . . by writing for the illustrated booklet, "VINYLITE Extrusion and Molding Resins and Plastics." Address Dept. RT-43.



LONG-WEARING handle bar grips emphasize the many outstanding features of VINYLITE Plastic flexible compounds — lasting flexibility, wide color range, resistance to perspiration. By Hungerford Plastics Corp., Rockaway, N. J.

TOUGH, RESILIENT vacuum cleaner parts, molded of VINYLITE Plastic flexible compounds, can take long, hard usage. Production is quick, economical; any color can be specified. By Hungerford Plastics Corp., Rockaway, N. J.

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JOURNAL

Vol. 9 October, 1953 No. 8

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The Society of Plastics Engineers Journal is not responsible for the views expressed by individual contributors. Copy for each issue should be received at The Security Bank Bldg., Athens, Ohio before the first of the preceding month.

Across the Editor's Desk

• Plastics Around the World, our abstracts of the foreign magazines, turns out to be a solid hit with the membership, and once again we take off our editorial hat to those fine people who abstract the journals for us faithfully and without pay. They are serving the plastics industry in a very real and important way.

We need abstracters for four of the magazines we receive. One is the large and interesting Canadian Plastics. Also looking for an abstracter is a minor journal in Geman, published in Austria, Osterreichische Plastics Rundschau; and Ajour SNI, in Norwegian.

WELCOME PITTSBURGH SECTION OF SPE

These abstracting jobs are important jobs—if you can spare a few hours a month, please write to us.

• We wrote to about a thousand materials suppliers, machinery people, mold makers and the like to see what magazines were being regularly published for people in the plastics business. We got back a stack of mail that measured just under four feet in height! To all those nice people, our thanks. But it turns out that there are about a score of monthly or quarterly publications which qualify as magazines; and without exception these are the best laid-out and most attractive publications there are, and most of them have articles of real interest to the plastics molder, fabricator or retailer. An article on these publications is coming up next issue—hope we didn't overlook **anyone!** This article will round out our series on the sources of plastics information; two previous articles have covered the commercial magazines and the government reports.

• We have just received one of those wonderful invi-

SPE PRIZE PAPER CONTEST

$200 $100 $50

Who may enter? Everyone.

What may be the subject matter? Any phase of the plastics industry; material, machinery, processes, etc.

What length should the paper be? Long enough to tell the story. There are no restrictions on length.

When must it be submitted? As soon as possible; not later than the first of November.

Where should it be submitted? To your local section, or for non-members, to the nearest local section or national office.

Why should I write a paper? To let the men in the plastics industry know that **you** have something on the ball, that **you** can work out new ideas. To help others in your industry. Perhaps to make a little spending money.

Now...a new and STRONGER MOLDING MATERIAL

...highest ever in high-impact phenolic!

Durez now offers you a phenolic plastic molding material having an impact or shock strength in foot-pounds per inch (Izod) ranging up to 27.

This compares favorably with some metals. It is several times as great as the impact strength of molding compounds in general use, the highest impact commercially practical in phenolics to date.

Fiberglas*, the strengthening agent, is used in a manner that conserves the industrially valuable properties of Durez molding phenolics.

Known as Durez 16221, the new material invites consideration for a large variety of applications. It has excellent dimensional stability, a high modulus of elasticity, good electrical properties and resistance to water, heat, and chemicals. It will withstand far higher service temperatures than cellulose-filled materials.

Fiberglas*-filled Durez 16221 is natural in color, comes in dry form, and is readily molded by standard compression methods. It produces parts or components having dependably uniform characteristics.

As specialists in phenolics for 32 years, we offer you the counsel of our field technical staff in investigating the profitable application of Durez 16221, which is now in commercial use.

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Want More Facts and Figures?

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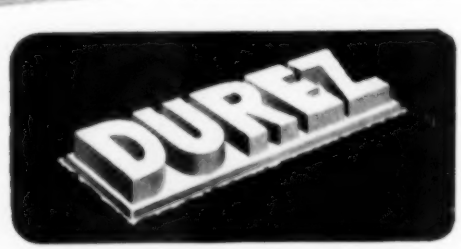

PHENOLIC PLASTICS THAT FIT THE JOB

Across the Editor's Desk

(continued from page 3)

tations which we can't take advantage of. The Forening For Norsk Plastindustri invites us to an International Plastics Exhibition in Oslo, May 31st to June 9th, 1954. We'd like to go; and hope at any rate that some SPE members will be able to.

• Ajour SNI is a plastics magazine that we mentioned but still had not seen when we wrote our article last Spring on plastics publications. We now have a copy of this attractive publication, which proves to be 40 pages long and is very well set-up. The April 1953 issue turns out to be volume 6, number 4, and contains the usual articles, ads, notices and book reviews. If you can read Norwegian, it would be a nice addition to your journal library.

• Noticed the new times at which the SPE Journal is arriving in your mail box? Probably results in some confusion for a little while, but we finally got smart and are publishing the magazine so that now it comes out in the month of issue, and not a month later. This business of moving up a month on publication does result in one peculiar thing: the September issue, coming out late in August, has Section News of the June meetings—but the October issue, coming out in September is published before the September meetings have been held, so you'll notice a real dearth of section news in this issue. For the information of section news reporters and others interested in getting material into the magazine, our new schedule runs like this; deadline for a given month is the first of the preceding month, and publication date is

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one week in advance of the month printed on the cover.

• A letter in response to some questions your editor asked is printed below for which our thanks to Bakelite's Mr. Hoffman.

Dear Dr. Day:

Mr. R. H. Bruce of our Hartford, Connecticut office has written to us requesting that we send to you our suggestions on the type of curriculum which prospective "plastic engineers" should study.

By virtue of our operations, we are able to place Chemical, Mechanical, Electrical and Civil Engineers, Chemists and Physicists at all degree levels. A more specific breakdown would be as follows:

Production Engineering-Maintenance-Plant Engineering

Chemical, Mechanical, Electrical and Civil Engineers at the B.S. and M.S. levels.

Technical Sales (Technical Representatives)

Chemical, Mechanical and Electrical Engineers and a few chemists at the B.S. and M.S. levels.

Research-Development

Chemical, Mechanical and Electrical Engineers, Chemists and Physicists at the B.S., M.S. and Ph.D. levels.

In an effort to acquire competent technical personnel, we actively recruit at some 42 colleges and universities on an annual basis. We firmly believe that our recruiting efforts pay splendid dividends in the number and type of individuals we place on our payroll.

We are, quite naturally, seeking the top men in each graduating class as measured by their academic standings, personality characteristics and faculty ratings. These tend to give us a good reading as to the individual's potential for both theoretical and practical work.

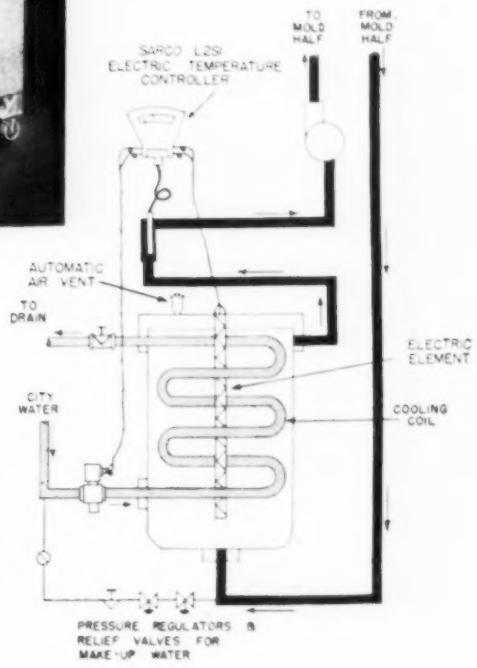
A person interested in entering the field of plastics should have background in the following areas: Chemistry (Organic, Analytical and Physical), Mathematics, Statistics and Statistical Quality Control, Unit Operations, Design (Mold), Instrumentation, Physics, a basic course in Plastics (if offered) and a good course in Report Writing. Also as part of the curriculum, plant visitation in the plastics industry, both in the raw material and fabrication plants would be helpful. To help round out the individual, we would suggest liberal arts courses in Economics, English, History and perhaps Psychology. Of course, participation in some extra-curricular activities is of some importance.

Prior to receiving a permanent assignment, these young persons are placed in either a formalized training program or are given on-the-job orientation. We are, therefore, more concerned with their basic knowledge.

(continued on page 32)

NEW
Mold Temperature Controller offers you many Exclusive Features

Sketch below shows one of the two water systems through which the Sarcotrol *Unit provides independent temperature control for each mold half.*



- Improves quality of molded parts
- Permits faster molding cycles
- Simplifies balancing of gates
- Permits optimum adjustments of cylinder temperatures, piston speed, injection pressures, etc.

THE *Sarcotrol* Mold Heating and Cooling Unit is designed specifically for the plastics industry—to meet all injection molding requirements to best advantage. It provides separately adjustable automatic control of each mold half, by means of two independent water circulating systems. Correct temperature is maintained within 1°F on either heating or cooling cycles.

Sarcotrol Units have also been successfully applied to control water temperatures of calender rolls for extruded sheets.

For the complete SARCOTROL ***story, ask for Technical Bulletin No. 7.***

SARCOTROL FEATURES

Circulates temperature controlled *water*, 50 to 250°F.

Completely automatic temperature control

Can be used on any size mold

Mold temperatures indicated on large dials

Automatic switching from cooling to heating

Highest pumping capacity—insures uniform mold surface temperature.

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House

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Ladies

John Charles Pavanel
Information

Barney Kellam
Professional Activities

Some Committeemen . . . . .

Tenth SPE Annual Conference

Here are some of the men working to make the 10th SPE Annual Technical Conference a rousing success. The Conference is slated for the Royal York Hotel in Toronto, January 26, 27 and 28, 1954.

JAMES E. PARKHILL a plastics sales specialist with Canadian General Electric Co., Toronto, is chairman of Advance Registration for the 10th Annual Convention of the SPE.

GLENN S. WOOLLEY, manager of Glenn S. Woolley & Co., plastic products manufacturers in Toronto is chairman of the Ladie's Committee for the 1954 Convention of the SPE.

ALAN J. McCONVEY, molded plastics section, Canadian General Electric, is a member of the Publicity Committee for the 10th Annual SPE Convention.

THOMAS A. McLELLAN, a sales engineer with Smith & Stone Ltd. Toronto, is chairman of the Luncheon Committee.

G. GORDON McALLISTER, advertising manager of Canadian Plastics, is chairman of the Printing Committee for the 10th Annual Technical Conference.

ROBERT HAROLD STRONG of Naugatuck Chemicals, Division of Dominion Rubber Co. Ltd., is chairman of the House Committee for the SPE's 1954 convention.

JOHN CHARLES PAVANEL a technical sales representative with B. F. Goodrich Chemical Co., Kitchener, Ontario is chairman of the Information Committee for the 10th Annual SPE Convention in Toronto.

Chairman of the Ontario Section Professional Activities Committee is BARNEY KELLAM of Toronto.

He is a member of the Ontario section of the SPE. He is also on three Canadian government specifications committees on plastics.

DOUGLAS E. FERGUSON, a member of the Programme Committee for SPE's 10th Annual Technical Conference is a technical sales representative with Canadian Industries Limited, Toronto.

Thomas A. McClellan
Luncheon

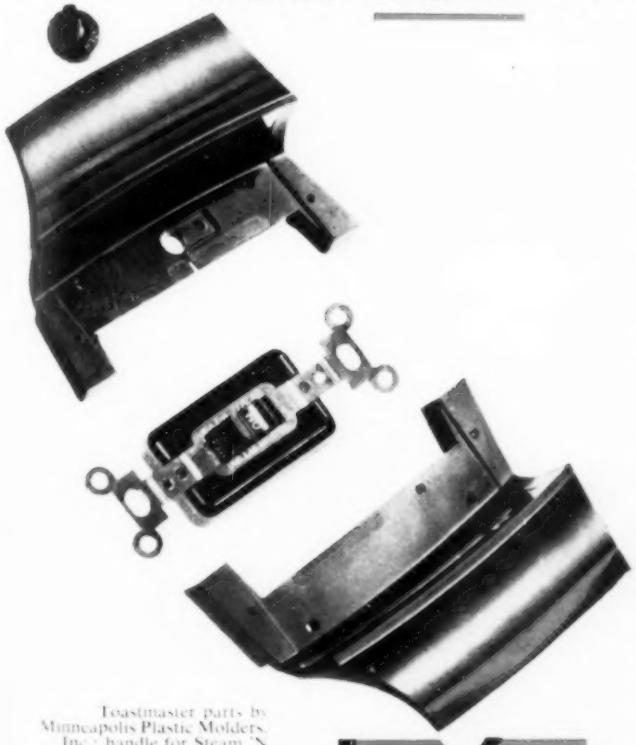
Alan J. McConvey
Publicity

G. Gordon McAllister
Printing

free flow... fast cure

for superior moldings

with new RESINOX 1004



Toastmaster parts by Minneapolis Plastic Molders, Inc.; handle for Steam 'N Dry Iron by Landers, Frary & Clark; Quiette switch by Arrow-Hart & Hegemann Electric Company

First and foremost, Resinox 1004 delivers the unusual combination of free, easy flow (particularly suitable for plunger and transfer molding) *plus* fast cure, fast as any phenolic now being offered the industry. More than this, Resinox 1004 gives you:

1. Good rigidity of set, giving freedom from warpage
2. Good mold release
3. Relative low specific gravity (1.36), for more products per pound
4. Good appearance
5. Greater uniformity

Here is the ideal range of properties to build outstanding performance in superior moldings. Good reason why so many leading household appliance manufacturers are today being supplied with handles, bases and switches molded of new Resinox 1004.

In molding performance, you'll find Resinox 1004 delivers extra advantages of faster cycles, easier flow and low specific gravity that make *more profits for molders.*

So if you are not already using Resinox 1004, investigate this new material now. Mail the coupon for full information.

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MONSANTO

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MONSANTO CHEMICAL COMPANY, Plastics Division, Room 2905,
Springfield 2, Mass.

Please send me full information on new Resinox 1004 for better, more efficient molding.

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Company

Address

City, Zone, State

Your National Office

Your Executive Secretary has been living out of a suitcase for much of the month of September, having traveled over 2500 miles.

The Western New England Section meeting was the first stop. Ed Childs, Section President, kept the program of prizes, speeches, and movies going along at a stimulating clip. The enthusiasm of the entire group was contagious.

The Connecticut Section had a good turnout for its first meeting of the season. David Mersey, Section President, was the main speaker of the evening. Constructive suggestions on possible improvements in the Society were offered and more than welcomed.

In the New York Section meeting, as a matter of fact, I unexpectedly got in on their annual "complaint session." Under the leadership of Saul Blitz, Section President, problems were soon brought into perspective. The informality, excellent organization, and lively interest of the New York members were especially impressive.

Tours of Pro-Phy-Lac-Tic Brush Co. arranged by Herb Hasenzahl; Noma Lites, Inc., by George Martin; The Bryant Electric Co., Hemco Plastics Division, by Elias Greninger; and visits to the offices of Monsanto Chemical Co.; American Cyanamid Co.; Bakelite Co.; and Tennessee Eastman Corp. all proved very much worthwhile.

This brief survey of the industry confirmed the fact that the plastics industry is strongly behind your Society. The important part the Society of Plastics Engineers has in serving the entire plastics industry, through its work with the individual members who make up the industry, is recognized and appreciated.

The Annual National Technical Conference is one of the means your Society has of fulfilling its purpose. The 1954 Conference Committee recently met with your National Council in Toronto, the site of the coming conference in January. The program covers subjects of immediate interest to the men in the industry and includes a social program that should be most attractive to both men and their wives. All indications are that it should be a bigger and better conference than ever. Make your reservations early!

It was my first visit to Toronto. It is only a two hour trip by plane from New York City. Across Lake Ontario from Rochester, New York, Toronto is a beautiful city with just a slight flavor of European atmosphere to it. It also gives the feeling of being a boom town with all the excitement that goes with it.

It was fortunate the Council meeting was scheduled for the 15th. The week before Toronto was sweltering in 98° heat, as was much of the United States.

The National Council directed that my Activities Report to them be published. Look for it under

(continued on page 34)

First WITH WEIGH-FEEDING

GLENGARRY'S INJECTO-WEIGH turns weigh-feeding into profit for you—the injection molder. An accurately-weighed charge of plastic practically eliminates shorts, flashes, rejects; reduces stresses, strains; saves material as compared with old-fashioned methods. For more information about weigh-feeding and the Injecto-weigh, write:

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BAY SHORE · NEW YORK

Forum on . . .

PRINTED CIRCUITS

Edward Drinkwater, Arnold Babbe, George de Beaumont

Edward Drinkwater, George de Beaumont
and Arnold Babbe, with Robert L. Whann

This panel discussion was designed to present the major important considerations on printed circuits from the view points of an electronics designer, a material supplier and a fabricator.

The panel members were Mr. Ed Drinkwater—electronics designer of Consolidated Engineering; Mr. George de Beaumont—material supplier of Synthane Corp., and Mr. Arnold Babbe—fabricator of Technical Reproductions Corp.

The forum, which was held at the February meeting of the Southern California section of SPE, was unique in the way of panel discussions. Some weeks prior to the meeting, the three panel members got together and pre-arranged the questions and answers which were to be presented. These questions and answers which are published herein were designed to cover the major considerations and problems which are generally faced by users and fabricators of printed circuitry.

The pre-arranged questions were posed to the panel by the moderator Mr. Robert Whann, Plexolite Corp.

Q. Does the conversion from a conventional electronic circuit present a problem that requires a specialist?

A. As long as the printed circuit contains no printed electrical components, special shielded circuits, or other complex wiring problems, there is a great deal of similarity in the packaging and wiring of a printed circuit and conventional electronic wiring. The problems of interwiring capacity and acceptable voltage drop in conductors is the same in both cases and could be solved by a good technician provided he were supplied with adequate tables giving the necessary data.

Q. What main qualities in metal clad materials are most desired with respect to both physical and electrical characteristics?

A. For general purpose usage of printed circuitry as it exists today, it would be desirable to classify the general applications and the related electro-mechanical properties that pertain. Several of the general applications may be stated as (1) Flat card (single or double sided) printed circuits, (2) Flexible glass cloth, (3) Post-formed sheet application, and (4) Cylindrical tube etched circuits. In all of the applications stated the bond strength, temperature stability, homogeneous plastic base, moisture resistance, and warpage are usually critical factors. However in the case of flexible glass cloth and similar applications where it is feasible to mold an entire assembly in plastic it would be necessary for the bond and foil to resist the chemical reactions of the exo-thermic plastics normally used. In all applications the most important quality for production line usage is reproducibility, or a satisfactory guarantee that once a metal clad is selected for an application the material will not vary.

Q. What bond and material requirements are necessary for proper etched results?

A. Uniformity of bond, free from blisters. Pull strength approximately 8 pounds. More important, bond should be resistant to maximum heat temperature due to soldering problems. Bond must be acid and solvent resistant, necessary in the fabricating process.

Material should lend itself to machining and punch press fabrication.

Q. What are the bonding qualifications of copper to base materials in regard to:

a. Temperature reactions—specifically soldering
b. Resistance to acids and solvents

A. A number of adhesive films are being used for the bonding of metal foils to the base laminates. Many of these commercial adhesives are of the sheet type with a removable backing at the time of application. They are then cured under heat and pressure between the copper and the laminate.

Originally, the adhesive was selected for one of two qualities: One type gave an excellent bond but did not

have as good heat characteristics. Others were not as good for bond or pull strength but gave better heat resistance qualities.

Synthane and several of the other laminators have developed their own bonding agents which have excellent bond strength and heat resistance qualities, and also have electrical properties that are equal to that of the laminate itself.

As to bond strength, it is possible to conservatively offer a minimum bond strength of 5 pounds. This is tested by scoring the foil side of the laminate to produce a strip 1" wide. The foil is then pulled from the laminate and a clamp affixed to the foil strip. The test load is then applied at 90°.

As to temperature reactions two tests are used: (1) the oven test, and (2) hot solder test. In the oven test a specimen 6" x 6" is placed in the dry circulating air oven for 30 minutes. At the present time most foil clad laminates will withstand at least 275°F for 30 minutes without blistering. For the hot solder test, a specimen 1" x 1" x 1/16" thick with copper or aluminum foil on one surface is placed in a pot of molten solder, foil side down. Our tests to date indicate a temperature of 425°F for 10 seconds can be guaranteed.

Let it be said that these values are minimum and conservative as results far exceeding them are continually being obtained. Also, bond strength and temperature reactions will vary according to the thickness of the foil used. The thinner the foil the poorer the bond strength, as foil increases in thickness the bond strength is improved.

With respect to resistance of acids and solvents, most adhesives used in metal clad laminates will resist the acids and solvents that will normally be resisted by the laminate itself.

BASE MATERIALS

Q. Do the base materials of copper clad laminates conform to electrical qualifications as established in materials now used to support wired circuits?

A. Yes. To date we have found that XXXP and specifically Synthane Grade XXXP-IR is the best laminate for the production of metal clad materials. It combines excellent electrical properties, good machinability, permits punching and is hard enough to permit production of a smooth surface after the foil has been bonded.

XXXP-IR also is exceptionally low in moisture absorption characteristic and its insulation resistance is much greater than other phenolic laminates.

However, for special applications where other factors such as special machining characteristics, impact strength, arc resistance, or price are desired other grades can be furnished. These are XXXP, XXP, XXX, X, L, LE, and G-5.

In some cases Underwriter's Laboratories insist on the base laminate having flame retarding properties and such materials have been developed which are close to all of the above mentioned grades and meet the Underwriters laboratories tentative specification. The addition of flame retardent properties to the base laminates does affect adversely the electrical properties of the laminates.

Q. Is it possible to improve copper surfacing to enable reproductions of finer details?

A. This is difficult to achieve since the laminator must obtain copper ready for use generally from one source only. This copper foil is an electrolytical deposit type and as such is subject to various minor and minute imperfections. This is especially true in the case of extremely thin foil such as .00068" and is also true where extremely finely etched lines or circuits are required. It is known that a rolled foil would give best results in this type of application but at the present time it is not available in copper in production sizes. (The laminators and the users must cooperate in attempting to persuade the foil producers to improve their copper foils.)

Q. Why do not the engineers design more around the use of aluminum foil?

A. There is a general feeling that the best conducting material in terms of cost, availability, wear resistance and all around usage is copper. Most all tables of current carrying capacity and other electrical characteristics are defined in terms of copper. Stating it all rather directly, we might say that we are limiting ourselves to only one general purpose electrical conductor because of the precedent that has been previously established. Engineers as well as designers should be familiarized with the use of aluminum.

ALUMINUM VS. COPPER

Q. For production line usage, how does aluminum clad compare with copper clad materials?

A. Aluminum foil offers some excellent advantages. First, its cost is less than copper. Its availability is more certain since there are many more suppliers. It is reported also that the process time for etching aluminum is considerably less than copper and this makes for production line usage. The most serious disadvantage of aluminum is the necessity for special preparation to permit soldering.

Aluminum foils are being offered with zinc flashing, copper flashing, and copper annealed surfaces. This allows for good soldering practices. The most common thickness of aluminum foil used at the present time is .002".

Q. What materials have you found to be better for "flashing in" and what are the thickness limits?

A. Any materials other than nylon laminates, 1/8" thickness and over prove satisfactory.

Q. In reducing a two-sided printed circuit what is the best method to guarantee alignment?

A. Art and layout to be drawn 4 to 1 or greater. Pilot holes to be indicated, 4 preferred.

Q. Are there any component parts such as tube sockets, plugs, etc., specifically assigned for usage in etched circuitry?

A. A very rapid development in printed circuit components has been going on recently. Miniature 7 and 9 pin tube sockets, ribbon and wire connectors, crystal clips, terminals, and many others including blanked out boards with variable terminal mountings for the layout of printed circuits have been developed.

Q. Is is possible that an etched circuit may be so designed so as to adopt the use of crystal diodes?

A. A very recent new design of crystal clips has been made by the Metal Products Company of Los Angeles that may be staked into a printed circuit, eliminating the previously present problems of poor mechani-

(please turn to page 35)

The Retailer . . .
LOOKS AT PLASTICS

Ephraim Freedman
Director of Macy's Bureau of Standards

"How do retailers view plastics?"

Since the question has been asked I shall endeavor to answer it by referring to a recent survey conducted in our own establishment. In this connection, attention is invited to the fact that each buyer interviewed had been asked to speak freely and to approach the subject from any angle he cared to choose. Therefore, the many angles presented on this subject should give the reader much food for thought.

CONSIDERABLE CONSUMER DISSATISFACTION and ill-will have resulted from the sale of garments containing plastic polystyrene buttons and jewels. The buttons soften or melt when contacted with a hot iron, dissolve during dry-cleaning, stain adjacent fabric and, because of jagged edges frequently cut the fabric during dry-cleaning or laundering.

Some plastic buttons are surface dyed. Sometimes the dye comes off in washing or dry-cleaning. Already, one large retail organization has stated that it will not accept opaque polystyrene buttons on garments because dry-cleaners cannot readily identify the buttons as being made of polystyrene and, therefore, do not always remove them before dry-cleaning.

A seeming paradox to this problem exists in our Notions Department which claims to have no problems with plastic buttons.

From our Housewares and Drug Department comes word that plastics have greatly curtailed the volume of the brush business. This is attributed to the use of plastic bristles. The items involved are various cleaning brushes and hair brushes.

Plastic covered cord line has made considerable inroad over cotton sash cord. Wire cored plastic lines are considered as being superior to the cotton-cord lines because of greater strength.

Nylon mops for dry dusting have increased sales appeal. Appearing first in white, they are now coming forth in various colors. They are not attacked by moths or mildew. However, because of built-up static charges, particularly in dry, cold weather, they cause dirt to drop on to the floor thereby creating annoying situations.

GARMENT BAGS

Garment bags made of polyethylene of about 2 gauge thickness have found considerable acceptance for storage purposes. For every day use, vinyl bags, ranging from 3½ gauge and up, are very popular. One of the problems confronting consumers arises out of the occasional softening of vinyls when contacted with paradichlorobenzene, a moth killer.

Our Housewares Buyer reports that he is confronted with a continuing problem of justifying price on vinyl yard goods, tablecloths and garment bags because of competition with products of questionable quality. He avoids complaints regarding quality by purchasing from a few reputable manufacturers, but feels that they can be of material assistance to him if they would affix informative labels to their products.

He feels that it should be mandatory to label reclaimed vinyls as such.

TABLECLOTHS

In the tablecloth field he carries a minimum of 4 gauge vinyl which has to compete with 2 gauge vinyl cloths. The latter, because of relatively poor quality and flimsiness becomes brittle, cracks and tears. He states that the average customer is dead set against plastic tablecloths because of unpleasant experiences with cheap merchandise which in addition to the deficiencies previously mentioned, also suffer from color transfer and loss particularly in use. His comments also hold for plastic shelving.

His opinion regarding plastic garment bags is that the business is good and that there are relatively no complaints. This opinion is shared by the Closet Shop Buyer and by the Notions Buyer.

He points out that manufacturers can assist retailers in expanding the demand for worth-while shelving, edging, piece goods, tablecloths, curtains and draperies if they will provide adequate displays or help retailers with display problems. Informative labels, he believes, would materially assist in increasing consumer acceptance of these plastic articles.

Just as the Housewares Buyer has found it profitable to trade up on quality, so has the Linen Goods Buyer.

She finds that trading up of quality in plastic table cloths is helping sales. Some complaints are received because of odor. Plastic coated 80 square table cloths are making a definite inroad on the plastic film cloth business.

She carries 2 gauge clear polyethylene table cloth covers and 3½ gauge or better vinyl film covers.

The sale of plastic table mats is dropping off.

In plastic table cloths, style is most important. There remains much to be done in this field.

Simulation of textile weaves has been suggested and

pursued with some success, but the removal of food particles and stains requires somewhat more effort on the part of the customer because of the surface effects of these cloths.

In the raincoat field, vinyl garments made of a minimum 4 gauge film are definitely acceptable. Sales level has been high, and volume has been maintained. This has been helped by substitution of heat sealing for sewing of seams and by extra reinforcements at points of strain.

RECLAIMED VINYL RAINCOATS

Raincoats made of reclaimed film are no longer being freely offered. Plastic raincoats cannot compete on style with fabric garments, but they are widely accepted as utility coats for protection against rain.

Informative labels are sometimes affixed to these garments, but the information is generally sparse.

One of the problems confronting customers of plastic raincoats is how to shorten them.

Plastic rain hoods are more or less popular. Some manufacturers have produced checks and plaids which have not had much eye-appeal. However, a pin-check printed plastic raincoat has been very successful.

Plastic-coated gingham raincoats have sold fairly well.

Customer complaints arise from failure at pressure points, particularly pockets, the tearing out of snaps and the pulling out of buttons.

In luggage, unsupported vinyls lack stitch strength. They are relatively unattractive. Vinyl bindings, once they are cut, part readily. Acetate bottoms on golf bags have not been successful. They have cracked. Molded rubber bottoms with rubber studs have supplanted them. Trimmings made of heavy gauge vinyl are proving very serviceable.

Plastic laminated fiberglas fishing rods are rapidly supplanting metal and bamboo rods—which makes it possible to sell more durable rods at lower prices.

Our Adult Games Buyer is still looking for Mah Jong tiles that won't change color. Polystyrene is the plastic presently used. The demand for these tiles is slightly on the decline.

TOY BUYER

Except for non-rigid plastics, resistance is building up to plastic toys. This is attributed principally to the large incidence of breakage resulting when toys made of polystyrene are dropped or otherwise subjected to impact.

More people are turning to metal and to wood toys. It is easier to sell a $1.98 metal toy than a $1.50 plastic one. Plastic wading pools are in great demand because of safety, convenience and ease of storage. Once in a while the job of maintaining them inflated creates a problem.

We have had to reject polystyrene toy guns. Guns made of acetate, however, are satisfactory from a durability angle.

Plastic laminated fiberglas bulk toys will soon make their appearance and will, undoubtedly, prove to be very successful.

Very little labeling accompanies plastics except on inflatables. Vinylite plastics usually carry good informative labels.

From another housewares buyer, comes the following information—Most rigid plastics still present a breakage problem. There is a definite trend away from polystyrene to polyethylene for refrigerator containers and for storage.

Furthermore, polystyrene articles frequently have sharp or jagged edges which result in personal injury. This condition is not due to the polystyrene but rather to the conditions of manufacture of the item and the unwillingness—because of the cost factor—of the manufacturer to grind down the offending edges.

Melamine plastics are proving very popular particularly in dishes. The use of color is increasing the sale of this merchandise. However, more brilliance is required to further expand its use.

TABLEWARE

Urea-formaldehyde dishes sell only in the spring and summer generally for picnic use.

Plastic-handled knives usually are to be found on lower-end merchandise. Customers prefer wood or stainless steel handles.

Plastic covered hampers are in good demand. Plastic egg cups are cheap and break readily. Egg cups made of nylon, melamine or polyethylene should sell well.

Bathroom tumblers of polystyrene are considered unsatisfactory because, while they are cheap, they break too readily.

Nylon tumblers, while expensive sell fairly well. Melamine tumblers sell well and at half the price of nylon cups.

While much that I have presented regarding polystyrene has not been too favorable in terms of its performance, polystyrene wall tile is meeting with an increasing amount of consumer acceptance. However, that acceptance is tempered by price and by the aggressiveness with which the tiles are promoted.

This buyer also reports a good business in 4 gauge and 6 gauge shower curtains and states that the latter are more acceptable. One problem he faces is that of matching colors when a customer wants an extra curtain for an ensemble.

The subject of plastic floor coverings is of growing interest to retailers.

SOME CONCLUSIONS

From the information which has just been presented, I believe that certain conclusions can be drawn. Among them are these:

1. Certain plastics are being used in fields where, although they may satisfy the price factor, they are not sufficiently durable to maintain a high degree of consumer acceptance. On the contrary, they tend to cause plastics, as a whole, to be held in low esteem.

2. Some articles made of these plastics require more attention to finishing details if the amount of displeasure which they now cause is to be reduced.

3. Regardless of these findings, there will always be some demand for these articles, particularly when inability or unwillingness to pay a higher price for a more durable article is the prime factor.

4. Customer experience with plastics of this type have, it is reported, caused one manufacturer to desist from using the term "plastic" in connection with the sale of his products.

5. Plastics when used in fields where they add to the performance, durability, ease of use and of care, are meeting an ever-increasing consumer acceptance.

6. This acceptance can be strengthened and broadened by

   a. more attention to design, color and finish,
   b. assisting retailers to display their products to better advantage,
   c. a continuing educational program through the use of informative labels.

7. Standards based on end use of products will tend

(please turn to page 35)

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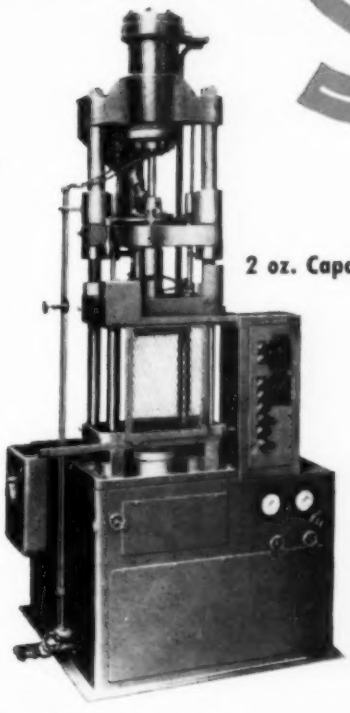
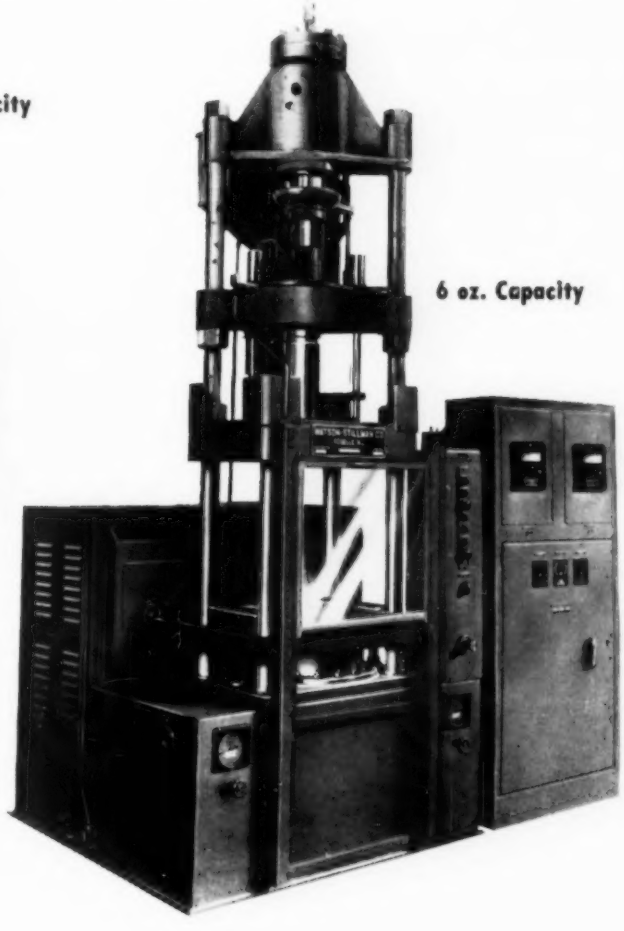


2 oz. Capacity



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Polystyrene Reinforced With Glass Fibers

H. G. Guy
Koppers Co., Inc., Chemical Division

THE ADDITION OF GLASS fibers to polystyrene increases the stiffness (modulus), tensile, flexural, and impact strengths, as well as the dimensional stability (heat distortion) of this thermoplastic resin. The degree of improvement in physical characteristics is determined to a considerable extent by the amount or proportion of glass fibers to polystyrene. Obviously, the greater the length of the individual glass fibers with uniform distribution, the greater the increase in physical strength. The length of these glass fibers is limited by the molding procedure employed and the design of the mold or die. These factors are in turn modified by the heat, pressure, and other operating variables.

IN RECENT YEARS the use of polystyrene in combination with random glass-fiber mat received considerable publicity which was possibly a little premature. The impregnated glass-fiber mat was used for compression molding, and the chopped, impregnated mat was tried for injection molding. The pressure, time, and heat needed to form this material in standard compression molding equipment was found to be greater than that needed for polyester and phenolic thermosetting resins, but the pieces produced had no noticeable advantage over the thermoset resins except in color.

INJECTION MOLDING

In injection molding, impregnated random glass-fiber mat was diced into roughly $\frac{3}{8}$" thin squares. These diced squares were used successfully as an injection molding compound. This use was successful inasmuch as molded pieces of good tensile and impact strength were obtained without injury to the molding press or to the die. This was indeed startling, since the impregnated mat contained 30-40 per cent glass fibers by weight, and the abrasive action of glass fibers on polished metal surfaces is well known. Apparently, in the plasticizing cylinder the polystyrene in this combination floated to the surface and then acted as a lubricant protecting the cylinder, the nozzle, and the die of the injection molding press. The maximum fiber length contained in such pieces was $\frac{3}{8}$", and as might be expected, most of the fibers were much shorter due to breakage while passing through the nozzle and gate to the mold. The average fiber length was found to be less than $\frac{1}{4}$". Unfortunately, the bulk of the diced, impregnated glass-fiber mat was such that it was impossible to handle this material in conventional equipment. The material was so fluffy and light that it would not flow through the hoppers and feeding devices, and furthermore, it was impossible to obtain more than about a 2-ounce shot with an 8-ounce machine.

The physical properties of the molded pieces obtained from diced, impregnated mat were improved in impact, tensile, and other properties. However, the improvement over unreinforced polystyrene was not great enough to justify the extra expense in handling this awkward, fluffy material.

The low cost per pound for polystyrene as well as its low specific gravity, plus the other well-known excellent physical and chemical properties of this widely used resin suggested continued trials with glass fiber-polystyrene combinations. For this reason we have continued and are continuing our investigations with such combinations as injection molding compounds.

The first step taken was to replace the random glass-fiber mat with glass fiber roving. This not only substantially lowered the raw material cost of the glass fibers but also reduced considerably the bulk of the impregnated molding compound. This increase in density of the impregnated, chopped roving permits its use in conventional injection molding presses without difficulty and without modification of hoppers and feeding devices. We have found it possible with an 8-ounce machine to cycle a 4-6 ounce shot without difficulty. Anyone who has attempted to mold the impregnated mat will appreciate how great an improvement has been made with this simple step.

LOW GLASS CONTENT

The second step was to investigate polystyrene-glass fiber combinations in which the amount of glass was greatly reduced. Polystyrene-glass fiber combinations containing more than 40 per cent glass fibers by weight are extremely difficult to mold in injection molding equipment due to the poor flow properties of this mixture. Increasing the polystyrene content increases the ease of molding greatly, while the decrease in tensile, impact, and other physical properties is slight to moderate. In fact, the reduction in heat distortion is very slight. In the attached table, the results obtained in our laboratories with conventional full-scale molding equipment and with different ratios of glass to polystyrene, are summarized.

It is difficult to wet glass fibers with molten polystyrene. Therefore, it is customary to impregnate glass fiber reinforcing agents with water dispersions of polystyrene. This is true whether the glass fibers are in the form of a roving, mat, or woven cloth. The use of water dispersions, because of their low viscosity, permits thorough impregnation of the glass-fiber bundles. Of course, it is necessary to have a resin of extremely fine particle size in these water dispersions. In our investigations, Koppers Polystyrene Emulsion R was used. This is a stable high solids water dispersion of high molecular weight polystyrene, with the polystyrene having a particle size of less than one micron.

DRYING TOWER

The impregnated glass fibers are passed through a drying tower where the water is driven off and the polystyrene is fused to the fibers. It is difficult to add more than 100% resin to the glass fibers through water impregnation. A slight increase can be obtained through the

use of thickeners to increase the viscosity of the treating bath. The increase in viscosity is limited by the need for complete penetration. For these reasons, chopped, impregnated glass-fiber roving containing 60-65% polystyrene may be considered the maximum practical resin content.

Utilizing the impregnated roving containing 60-65% polystyrene, we have found it possible to increase the polystyrene content to any desired amount simply by rough tumbling the chopped roving with polystyrene pellets. When this rough admixture is charged to the plasticizing cylinder of the injection molding press, complete mixing of the resin with the glass fibers is obtained. It is essential, however, that high molecular weight polystyrene be used in these additions, and we have found that the best results are obtained with Koppers Type 8 in high heat distortion polystyrene.

MOLD IN CONVENTIONAL PRESS

As indicated above, these polystyrene-glass fiber combinations can be molded without difficulty in conventional injection molding presses. The material may be cycled, and we have been able to make pieces with a total overall cycle of less than one minute. Best results are usually obtained when the plasticizing cylinder is at 450°-550°F., front and rear. A temperature of 600° or higher is harmful and should be avoided, since it tends to burn off polystyrene, leaving the glass fibers behind. While it is possible to mold these combinations with plasticizing cylinders at 300°-350°, the resultant pieces usually have poor physical strength due to incomplete knitting.

The glass-fiber compounds should be injected into the mold as rapidly as possible, and for this reason, boosters or maximum pressures should be used. Roughly a 30 per cent increase in pressure over that used with unmodified polystyrene is required. Every attempt should be made to eliminate packing and to fill the die in one shot. The cushion or heel in the plasticizing cylinder should be kept small; otherwise the injection pressure is dissipated by the fibrous nature of the injection molding compound, and there will be difficulty in completely filling the mold. It is also necessary to heat the mold in order to eliminate welds and to obtain a good surface. With polystyrene-glass fiber combinations the welds are very weak and must be eliminated. The best results are usually obtained when the mold is held to 125°-175°F. It might be well to point out at this time that the surface that will be obtained in the molded piece will not be as glossy or as smooth as that with unmodified polystyrene. The best that can be expected is a satin-type finish.

It is also generally advisable to vent the mold since the material tends to trap air or gasses. Mold design is, of course, important, and while some restriction in the gate is desirable, pinpoint gating and edge gating should be avoided, because this type of gating tends to destroy or shorten the length of the glass fibers.

We feel that polystyrene-glass fiber combinations such as described above are potentially useful and have therefore made these products available on a semi-commercial basis. Such combinations undoubtedly will be used to mold specialties, and we do not expect large volume acceptance at this time. Where a piece with unusual heat resistance, good tensile and impact strength over a wide range of temperatures and with little elasticity and high rigidity is needed, these combinations offer great possibilities.

VARIETY OF COLORS

Polystyrene-glass fiber molding compounds may be had in a wide variety of colors, including both translucent and opaque shades. The present prices for this material are rather high, due to the small volume being produced. The price is determined by the amount of glass fibers. The lower the amount of glass fibers, the lower the cost.

The above has been given largely as a progress report. We feel that the entire possibilities of utilizing glass fibers to reinforce polystyrene have not as yet been completely explored, and we are continuing our investigations in our laboratories with the object of further improving this material. Should these results prove successful, we will report them to you.

INJECTION MOLDED GLASS FIBER REINFORCED POLYSTYRENE
PHYSICAL PROPERTIES—TYPICAL ANALYSIS

	Per Cent Glass Fibers by Weight			Comparative Values(a)	
	40	20	10	Koppers Polystyrene Type 8	Koppers Modified Polystyrene MC-301
Specific Gravity ASTM D792-48T	1.33	1.19	1.12	1.05	1.05
Tensile Strength, psi. ASTM D638-49T	11,000	9,000	8,500	8,500	6,000
Elongation in Tension, % in 2" ASTM D638-49T	1.1	1.3	1.3	1.5	11
Tensile Modulus, psi. x 10^5 ASTM D638-49T	1,177	815	692	519	
Compressive Strength at Yield, psi. ASTM D695-44T	15,000	14,500	16,000	14,000	13,000
Flexural Strength, psi. ASTM D650-42T	13,000	11,000	11,000	10,000	9,500
Notched Impact Strength (Izod) (Ft. Lbs. per Inch) ASTM D256-43T	1.7	1.0	0.6	0.3	0.04
Unnotched Impact Strength (Ft. Lbs. per Inch)	4.0	2.6	2.6	0.0	5.9
Deflection, Inches ASTM D790-49T	0.06	0.00	0.07	.14	0.4
Heat Distortion	221	218	218	201	175

(a) These materials contain no reinforcing agents and their values are included for comparison.

Forum on . . .
The Education Of The Plastics Engineer

Presented at the Ninth SPE Technical Conference

I. A Survey of Present College Instruction

C. C. Winding
Cornell University

Your S.P.E. Education Committee, first organized in 1946, has had a large part in this promotion of plastics engineering, as one of the most active groups within the Society dealing with this problem. The Education Committee has been given the responsibility of advancing the theory and practices of engineering and related sciences pertaining to plastics by: 1) establishing programs in plastics technology; 2) encouraging technical schools in the adoption of these programs for an improved training for engineers entering the plastics industry, and 3) maintaining high standards of technical education for the plastics engineer.

Our assignment has not been an easy one. It is not sufficient simply to devise "ways and means" for the establishment of high standards in plastics education and hope that these will meet with a ready acceptance from all concerned. To the contrary, in order that any of our ideas for improvements in the training of plastics engineers might be acceptable, it is first necessary that we come to some agreement as to what constitutes "Plastics Engineering" and a clear understanding as to how achieve the status of a "Plastics Engineer" through formal and industrial training. With a very rapidly growing and fast changing industry, utilizing the services of highly trained engineers for its development and future expansion, it is essential that any program for the training of its technical personnel must be designed in terms of the requirements of the industry, some five or ten years hence, and in keeping with the educational facilities of our technical schools who will be teaching the plastics engineers of the future.

(Introduction by James M. Church of Columbia University)

A SURVEY OF the amount of instruction offered by universities in the field of high polymers in general was made by the S.P.E. Education Committee in 1951. Since that time additions and corrections have been made as information became available. A questionnaire was circulated asking for information regarding offerings involving complete courses on high polymers and courses in which only part of the time was spent on high polymers. Basic courses in organic chemistry were excluded since it was assumed that some attention would be given to polymers and polymerization in such courses.

With one or two exceptions, universities that had accredited chemical engineering curricula were selected because such curricula should indicate the existence of strong departments in both chemistry and engineering. Thirty-seven replies were received out of thirty-eight and, although this number is small enough so that additions would change percentages appreciably, a complete survey of all colleges giving engineering degrees would indicate even less interest in the field.

The questionnaire was made as broad and all-inclusive as possible since it was felt that we were interested in the maximum amount of information regarding all types of courses relating to high polymers, rather than in any specific information regarding quality of the subject matter in specific fields. For that reason, some courses on cellulose, paint and varnish, etc., are included in the summary but an attempt has been made to estimate the fraction of such courses that could be considered to be instruction in high polymers.

Credit hours have been used to indicate the amount of instruction in this summary. Normally one credit approximates 15 hours of lectures or 30 to 45 hours of laboratory work per semester. This is not a very accurate method and involved a considerable amount of estimating and guessing in evaluating the questionnaires. However, it is accurate enough for relative comparisons. No credit was allowed for research or thesis work.

There are several additional facts of interest that were obtained from this survey:

1. With exception of fractional parts of courses devoted to chemical technology or non-metallic materials of construction, only one institution had as much as a single required undergraduate course in the field. Nearly all courses are electives for seniors and graduate students.

2. Apparently there are almost no courses or even parts of courses offered outside of chemistry and chemical engineering departments.

TABLE I
COLLEGE COURSES OFFERED IN HIGH POLYMERS

The following table summarizes the results obtained from the questionnaire:

Courses on High Polymers	Institutions Offering No.	%
More than 20 credits	4	11
10 to 20 credits	5	14
5 to 10 credits	10	27
1 to 5 credits	12	32
None	6	16
Total offering courses	31	84
Laboratory courses	14	38
By Chemical Engineering Departments	25	68
By Chemistry Departments	21	57

3. Although 38 per cent of the institutions replying offered laboratory courses, much of the laboratory work involved materials testing or chemistry. Only a very few schools have laboratory processing or fabricating equipment.

4. Only one university has a program even approaching that suggested by the Society of Plastics Engineers. Since the survey was made an announcement has been made of the establishment of a Rubber Technology Foundation at the University of Southern California which has, as one of its purposes, the development of specialized rubber technology courses in chemical engineering at both the undergraduate and graduate levels.

In addition to the above factual information, I obtained several opinions and impressions in informal discussions and correspondence on this subject. Most important, there is a very definite opposition to the introduction of **any required** specialized courses in undergraduate curricula. The trend is in the other direction. In fact, accrediting committees warn against specialization in curricula leading to general egineering degrees. This opposition to specialization extends into the graduate level at many institutions.

There is very little chance that laboratory frabricating, processing and testing equipment for high polymers will be installed except in special cases. Such laboratories are, in general, too expensive for elective courses. Even assuming space is available, it would be difficult to equip such a laboratory for less than $50,000.

In opposition to most of the above, there are indications of a growing interest in high polymers on the part of instructional staffs. An increasing number of younger instructors have had industrial experience in the field and are working more and more subject matter involving high polymers into existing, broader courses. In addition, the amount of research is relatively great. In at least one school, 30 to 50 graduate students are engaged in high polymer research, although no formal courses are offered. Neither of these factors is apparent in a survey of this type.

II. The Need for Plastics Engineers in Industry

Edward S. Bloom

E. I. du Pont de Nemours, Inc.

LET US FIRST LOOK at the requirements of industry from the point of view of numbers of engineers that might be needed. The survey which we have recently carried out among members of the plastics industry has shown that already there is a large unfilled demand for technical personnel with plastics engineering training, even though a really progressive plastics industry has been going for only a relatively short time.

Another factor which seems likely to influence the requirements for plastics engineers is that, as in the case of the chemical industry generally, the demand for technically trained people relative to non-technically trained personnel increases as the industry becomes older. As the industry becomes more mature the new technical developments take on greater significance relative to the original empirical approaches.

The processing or conversion of plastics materials is essential in almost all cases of their utilization. In this connection a basic understanding of viscous flow is important to various conversion methods. Thus it is believed that additional training and instruction in the rheology of polymer melts to develop a better grasp of the mathematical treatment of problems in viscous flow of non-Newtonian materials would be much worth-while. A broad knowledge of the information related to heat transfer would be useful in many phases of the plastics industry. Althuogh some might consider heat transfer to be of the greatest importance in the polymer synthesis phase, it is certainly a major factor in the plastics processing operations both from the point of view of getting heat into the plastics and removing it from them, since excessive heating is frequently deleterious.

A thorough understanding of the new developments in plastics processing or conversion would be a valuable background for engineers working in the plastics industry. Illustrations are the molding theory developed by Spencer and Dillon of Dow and the extrusion theory and design recently developed and reported by researchers in the Polychemicals Department of the Du Pont Company. It is believed that knowledge of such information as this plus a research attitude or approach can lead to desirable imaginative approaches in the area of new fabrication techniques. Although great strides have been made in developing more rapid and efficient fabrication techniques through the use of preplasticizers and the like, this is still an area that needs the greatest attention.

For the greatest advancement to take place in the industry, the plastics engineers must recognize that plastics are new engineering materials of construction. They must not be considered simply as substitutes in a given design for some other material. This substitute-concept, of course, generally comes along with the introduction of a new material and takes some time to be dispelled. However, a full appreciation of the real place of plastics as new materials of construction will certainly do much to promote their proper utilization.

There needs to be developed an imaginative approach to design of plastics parts and equipment which leads to

new designs that will capitalize on the unique properties of plastics and on the potentialities of new fabrication techniques. Again, it is basic background in current operations that will be valuable in promoting this imaginative approach that is so greatly needed.

A greater appreciation of the important properties of plastics and in particular the stress-time behavior is important to the proper applications of the materials as engineering materials of construction. Undoubtedly in the present plastics courses most of the more important properties and their methods of determination are considered. We must be sure that attention is given to those properties that are controlling factors in particular applications in order to overcome completely the bad reputation that plastics received as **ersatz** materials during World War II.

Although not everyone working in the plastics industry is going to be called upon to design a mold, many will, and even those who are not can benefit by a knowledge of the elements of mold design. Sufficient attention should be given to this so that all are familiar with the problems that confront the mold designer. This, of course, is an important part of the knowledge of present fabrication techniques and it also requires a knowledge of the properties of molten polymers. All people who are concerned with the design of products which will be important in promoting the plastics industry must be taught to realize that these products must be functional—that is, they will serve a purpose—and that they must also be practicable to produce. A frequent complaint by users of plastics parts has been the difficulty in getting efficient cooperation between their parts designers and the mold designers and manufacturers. Too often much time is wasted because the mold designer contracts for a particular job only to find out several months later that it is impractical—in the meantime the customer has proceeded with the rest of his layout based on the original design, all of which may then require extensive revision. I am sure that much of this tremendous waste can be prevented by a better understanding of mold design and of the properties of plastics by all concerned.

III. A Survey of Industry to Determine the Demand for College Trained Plastics Engineers

R. C. Bartlett

Natvar Corporation

TO EVALUATE the current industrial needs for and interests in "plastics engineers," a survey has been made. This was designed to determine the demand by industry for personnel having a training as outlined by the SPE brochure entitled "Professional Engineering Education in Plastics." Considerable care has been taken to put this survey on as broad a basis as possible. For example, care has been taken to solicit the opinions of large as well as small industrial organizations, of converters as well as raw material manufacturers, and of executives as well as engineers. Furthermore, this survey was planned to cover not only the plastics industry but also those industries which manufacture products involving the use of plastic materials as component parts. This last category includes industries such as the aircraft, automotive, electrical, heating, business machines, medical, communications, mechanical goods, military, electric power, toy, abrasives, and transportation.

The questionnaire has been sent out to determine statistically the industrial interests in "plastics engineers." It has been encouraging to have obtained a high yield of answers to this questionnaire, particularly since it could not be answered easily and quickly. This may reflect industrial interest in the general subject of education for technical personnel.

Without any qualification, the questions along with their summarized answers obtained by this questionnaire may be outlined as follows:

First question: "Does your company have need for personnel with training described in the SPE brochure?"
Answer: 98%, Yes; 2%, No.

Second Question: "List particular types of jobs in which you believe men with this graduate training and the following **undergraduate** backgrounds would be especially qualified."

a. Mechanical Engineering—Answer:
   1. Design and development 52%
   2. Research 4%
   3. Technical sales and service 14%
   4. Production 19%
   5. Other 12%

b. Electrical Engineering—Answer:
   1. Design and development 50%
   2. Research 9%
   3. Technical sales and service 17%
   4. Production 9%
   5. Production control 7%
   6. Other 9%

c. Chemical Engineering—Answer:
   1. Design and development 38%
   2. Research 16%
   3. Technical sales and service 11%
   4. Production 23%
   5. Materials engineering 3%
   6. Other 9%

d. Aeronautical Engineering—Answer:
   1. Design and development 71%
   2. Technical sales and service 14%
   3. Other 14%

e. Chemistry—Answer:
   1. Design and development 44%
   2. Research 36%
   3. Technical sales and service 7%
   4. Production 9%
   5. Other 4%

Third question: "Check which of the following ways you believe men with such training could be of special value to your organization."

a. Research—Answer: 15%
b. Development—Answer: 21%
c. Product Design—Answer: 14%

d. Production—Answer: 11%
e. Production control—Answer: 10%
f. Technical sales and service—Answer: 28%

Fourth question: "To what extent does your company find it necessary to provide on the job training in plastics?"

Answer: Many varied replies were obtained here, but they may be briefly summarzied as:

Do provide job training—98%
Do not provide job training—2%

Fifth question: "Which men would be preferable to your organization"?

a. A B.S. with a M.S. in the same field.—
Answer: 14%

b. A B.S. with a M.S. in plastics as described in the SPE brochure.—
Answer: 76%

Sixth question: "How many men do you now employ who would be more useful to you if they had this graduate training in plastics"?

Answers: Total—1204
"Do not know"
"Quite a few"
"All"
"Number—plus"

Seventh question: "Do you wish to make any comments which you think will be of value in this questionnaire"?

Answers: were varied but extremely helpful for this survey.

Although this survey could not possibly cover the plastics industry 100 percent, the sample of answers represents a well proportioned cross-section. It is worth noting that the answers to some of the questions are nearly unanimous while others require some interpretation. By a 98% response to questions one and four, it is clear that the plastics industry looks upon the SPE outline for "Professional Engineering Education in Plastics" with favor and is realistically confronted with this problem when industry now supplies most of the present education in this profession. From the numerous comments added to this questionnaire, it is apparent that industry expects to spend anywhere from three months to three years training their personnel before they become productive in this field. In general, it appears that the plastics industry is not satisfied with on-the-job training of their engineers and believes that the longer industrial training programs can be materially shortened by engineering education sponsored by the SPE. Education of technical personnel in the plastics industry is recognized as a major problem by both large and small organizations. I would venture a conservative estimate from the comments received on this questionnaire that industry spends over one million dollars a year in both tangible and intangible educational expenses. This large burden carried by industry may result from the combined lack of formal educational facilities and the relative newness of this profession.

Of particular interest and an unexpected outcome from this survey was the formation of a picture of the ways an engineer is employed in the plastics industry. Through this questionnaire it has been possible to arrive at a general statistical definition of a plastics engineer. Due to the lack of plastics engineers in the pure sense, industry has expressed its interests in other branches of the engineering profession as alternates in the following order of descending preference: chemical engineering, mechanical engineering, chemistry, electrical engineering, and last, aeronautical engineering. Results of this survey also show that a plastics engineer is most likely to be employed in research or development and after this he will most probably participate in technical sales and service.

Of particular interest is an analysis of the problem of replacement of men currently employed in the plastics industry. Assuming that the useful working life of a plastics engineer is forty five years, that the age distribution is uniform, and that the plastics industry is not expanding; it is estimated from 50 to 75 technicians are required per year only for replacement. Obviously, the last two assumptions are incorrect, particularly the supposition that the plastics industry will not grow. However, this does make this estimate of replacement very conservative. Considering the growth of our industry alone, this estimate can be multiplied by a factor of about five in 1963. On top of this is the problem of supplying a larger body of engineers to man a rapidly growing industry.

It is the desire of the Educational Committee of the SPE to continue this survey, so that a more exact answer can be obtained to the general problem of education of plastics engineers. This analysis is based on the results of this survey as it now stands. Accordingly, precautions have been taken to avoid making any conclusions where trends are not clearly shown.

IV. The Future Training of Plastics Engineers

Bryce Maxwell
Princeton University

WE HAVE READ something about the needs of industry for plastics engineers, the present status of plastics education and industry's demand for men with improved technical training. I should like to describe how the program of the S.P.E. Educational Committee is directed toward a solution to these problems.

As many of you know, in 1949 the Educational Committee prepared and presented to the society a program for Professional Engineering Education in Plastics. This program was directed toward the establishment of a standard curriculum at the graduate level for the training of Bachelors of Science in mechanical, electrical, or chemical engineering together with physicists or chemists in the fundamentals of plastics engineering. This program was designed to fill the needs of industry as we saw them at that time.

Today we have heard the results of a survey by Mr. Bartlett and the paper by Dr. Bloom both of which give a much clearer picture of the needs of industry. The question now becomes, does this program best serve the need as we see it in light of this new data.

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REINFORCED PLASTIC

F. Robert Barnet and H. B. Atkinson, Jr.

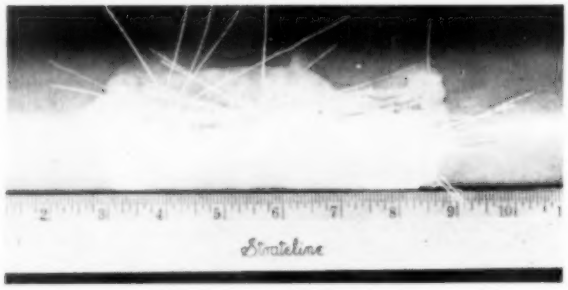
U. S. Naval Ordnance Laboratory

The authors examine a large diameter plastic tube at the Naval Ordnance Laboratory.

The Navy finds many unique applications for reinforced plastics as their wide variety of properties enables them to do specialized jobs no other materials can do as well. Electrical characteristics, corrosion resistance, light weight, and the advantage of using the less critical materials in their manufacture brings their use to the fore in naval ordnance.

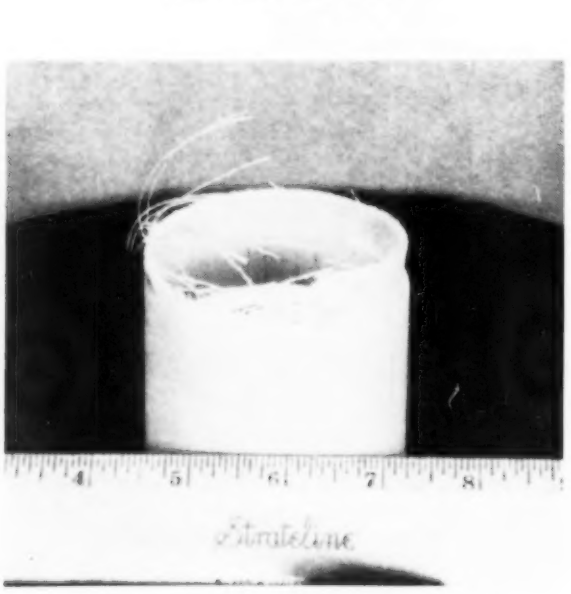
In addition to utilizing the special qualities of plastics, laminated materials are called upon to perform as structural members or as structural sections or as entire structural units. Several years experience with the problem has indicated that one of the most satisfactory designs involves basically a cylinder capped at the ends by a conical or hemispherical shape. Adhesive bonding is utilized as the method of assembly of the components and also provides water tight seals where required. Because of the structural requirements, glass cloth laminates have been used almost exclusively in present developments.

In naval ordnance, plastic units are required to resist varying types and degrees of loadings and generally the strength of the material must be maintained over a temperature range of from -65°F. to +160°F., as well as under other severe environmental conditions. Since the units must operate over this temperature range, the design safety factors must be set great enough to cover possible strength variations. Loadings may be of a static and/or a dynamic nature; most often both are encountered in the life of an item. As it is usually desired to keep weights as low as possible and still maintain strength, a good quality reinforced plastic of very uniform nature is required.



Typical Hoop Burst Failure

Moisture permeability of the plastic structure as well as its mechanical strength is of great importance. Various types of instrumentation are housed in plastic ordnance devices and they must be kept dry and operable, many times with extreme hydrostatic pressures surrounding the unit. Leak-proof laminates are, therefore, of considerable interest to the Navy. Although all plastics have a finite MVTR rate, the amount transmitted by a good laminate can usually be absorbed using a small quantity of a desiccant provided the basic structure is free from holes, thin spots, channels and delaminations which would allow a great quantity of moisture to enter.



This is an example of spiral burst type of failure.

Besides compressive strength, tensile strength, and impact strength, required for ordinary structural purposes, reinforced plastic units must also have resistance to bursting pressures and to collapsing pressures. It so happens in NOL's work that the bursting pressure requirement is primarily for small diameter tubes while the collapsing pressure is a requirement of the larger diameters. Time is an important factor in these properties; internal pressures are maintained for only short periods while external pressures may be maintained for

TUBING . . .

periods of many days. Rate of application of internal pressures is usually very rapid and requirements limit the designs to very small safety factors. External pressure loading rates, on the other hand, are moderately slow.

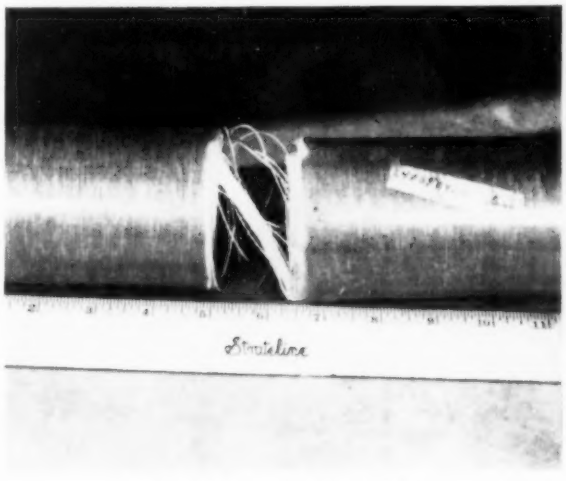
To provide the quality tubes which are required for NOL's work, an interim tube roller has been developed. Provision was made only for convolute rolling of glass fabrics and for wet impregnation of the cloth. Impregnation is carried out in a resin pan by drawing the fabric through a roller system designed to remove a maximum of air from the cloth and to replace it with resin. The first two rolls of the system are knurled. The fabric passing over them is worked back and forth opening up the weave and the yarns for quick wetting. These knurled rolls also pick up large quantities of resin which is forced through the fabric and flushes out air ahead of it. A pair of squeeze rolls then presses out more air and resin from the wetted fabric while it is immersed in the resin thus working it in still another way from the knurled rolls. Resin goes back into the cloth after the squeeze rolls and a period of soaking is then provided by traveling the cloth a distance under the resin. It has been found to be very important to allow sufficient time for this soaking so as to completely impregnate the glass filaments.

After leaving the resin pan, the fabric is wrapped under tension onto a steel mandrel. Care is taken to maintain a bead of resin between the mandrel and the cloth at the point of tangency so as to lessen the inclusion of air in the plies. When the proper diameter has been attained the tube is covered with #600 PT cellophane, tightly rolled on, to exclude surface air and wrinkles. Any remaining air in the tube is then squeezed out by a piece of flexible rubber hose around the tube. Following this, the cellophane is wiped with a methyl ethyl ketone wetted rag which helps shrink it tightly around the tube. The tube is rotated under an infra-red heat lamp bank with occasional wiping with methyl ethyl ketone to keep the cellophane tight until the resin gels. The cure is completed under the light bank followed by an oven post cure.

A variety of glass fabric weaves and a number of polyester and epoxy type resins have been used in producing experimental tubing. Resin viscosities have varied from 500 cps up to 6000 cps. Cures have been limited to the conditions described above and the catalyst system concentrations have been kept to the point where a gel time of 2-4 hours is maintained with the tube at approximately 100°F.

Bursting pressure tests made at the Naval Ordnance Laboratory have been confined to small diameter tubes and are performed under conditions of combined stresses. Specimens are prepared by machining the ends of the tube

This tube shows typical collapsing pressure failure.



Axial burst failure of plastic tubing.

with a scarf joint and by adhering metal end caps with mating scarfs to the tubes by means of an adhesive. One of the caps is provided with a tapped hole to which a water line from a pumping unit is attached.

In testing, the tube is first filled with water and all air eliminated from the system. Pressure inside the tube is then built up at a constant rate, following a pressure-time curve simultaneously plotted by an Esterline-Angus pressure activated recorder. The burst pressure however is measured accurately by a bourdon gage.

The tubes are taken to destruction so that the ultimate strength may be determined for design purposes and so that the type of break can be studied.

In the above tests the tube is simultaneously stressed under hoop and axial tension. If these forces are considered separately the hoop stress can be expressed as

$$S_H = \frac{P\,D_i}{2t}$$

and the axial stresses as

$$S_A = \frac{P r_i^2}{(r_o^2 - r_i^2)}$$

where P = internal pressure
D_i = inside diameter
t = wall thickness
r_i = inside radius
r_o = outside radius

From these formulae it can be shown that the ratio of hoop stress to axial stress,

$$\frac{S_H}{S_A} = \frac{r_o + r_i}{r_i},$$

approaches a value of 2 for thin walled tubes.

Since the warp fibers form the hoop direction of a convolutely wound tube and the fill fibers the axial direction, to develop the maximum strength weight ratio for resisting internal pressure, it is, therefore, necessary to have a reinforcement with approximately twice as much strength in the warp as in the fill. Special weave fabrics or spiral wound roving becomes of great interest because this desired balance can be easily obtained using these materials.

Tubing made from standard weave glass fabrics, special weave glass fabrics, and spiral wound glass roving have been evaluated by the Naval Ordnance Laboratory. When a tube formed from a reinforcement such as style #143 directional weave fabric is tested, the result is a burst at a very low pressure and a breaking off of the tube showing a typical axial failure which is in the weak fill direction of the cloth. When style #181 balanced weave fabric reinforced tubes are tested, a split is developed at burst giving a typical hoop type failure. This is expected as the hoop stresses developed are twice the axial stresses, while the tube has approximately the same strength in both directions. With special weave fabrics, exhibiting the 2:1 warp:fill strength ratio which theory dictates, the break is of a spiral nature indicating a shear failure. With style #143 cloth calculated hoop stresses of 12,000 psi have been developed as compared with 23,000 psi to 31,000 psi for style #181 cloth. These stresses may be increased by use of the special weave cloth to from 34,000 psi to 40,000 psi and by use of special wound glass yarn to approximately 70,000 psi.

Porosity in a tube shows up very effectively on a burst test. If there is any porosity, it has usually not been possible to take the tube to destruction because of the limited capacity of the water pump. In good tubing there is no indication of any leakage through the walls at pressures up to the burst strength.

External collapsing pressures present quite different problems for plastic tubing than do internal bursting pressures. For consistent pressure resistance uniformity of wall thickness, roundness of the tube, and constancy of the effective modulus of elasticity of the material are necessary. Tubes made by the same method as for bursting pressure studies are used by the Laboratory in this work, added care being taken to get a non-porous tube so as to minimize water leakage.

The specimens are prepared similarly to those for bursting pressure tests except for the use of sleeve joints when adhering the metal end caps to the tubes. Pressures are applied to the outside of the specimens by immersing them in a tank of water and then building up the water pressure by means of a hydraulic pump. The tests are therefore under conditions of combined stress where the axial compression loading is allowed to build up simultaneously with the radial loadings. The collapsing pressure is read off of a gage in the pressure line at the time of failure of the specimen.

Calculations of effective moduli are made by means of a formula (1), developed by Windenburg and Trilling of the Navy's David Taylor Model Basin, Carderock, Maryland.

$$P_c = \frac{2.42\,E}{(1-M^2)^{3/4}} \cdot \frac{(t/D)^{5/2}}{(L/D) - 0.45\,(t/D)^{1/2}}$$

where P_c = the collapsing pressure
E = effective modulus of elasticity
M = Poisson's ratio
t = wall thickness
D = neutral diameter
L = effective length

Development of this formula was primarily for application to metal structures undergoing instability type failures. It is also limited to "short" tubes (L/D equal approximately 6 or less) under simultaneous radial and axial loadings. With insertion of suitable values for Poisson's ratio and for the effective modulus of elasticity it can, however, be effectively adapted to the designing of reinforced plastic structures. The collapsing pressure tests at the Naval Ordnance Laboratory have been aimed at establishing suitable values for these two parameters. Since the formula includes the two ratios L/D and t/D, they have also been considered and data have been gathered to show their influence on collapsing pressure characteristics of tubes.

In the original test work, a value of 0.4 was assumed for Poisson's ratio. Later tests using a non-destructive collapsing pressure method (2), which allowed the calculation of the effective modulus from the slope of a pressure curve, and in turn calculation of Poisson's ratio, gave data indicating that the ratio should be taken as 0.3. In subsequent tests 0.3 was therefore used as the best value obtainable, even tho values ranging from 0.04 to 0.25 are reported in the literature for glass cloth laminated plastics. Such data have been determined under uni-axial loadings while multi-axial loadings are encountered when a closed cylinder is stressed under external pressure conditions.

Table 1 shows the variation in effective modulus and collapsing pressure with change in the L/D ratio. It is to be noted that there is a change indicated in the mechanism of collapse below a L/D ratio of about 1.7. Above this ratio instability is the primary mechanism of failure while below a yield type failure controls. Therefore, the instability formula cannot be used with any validity below this point. If specific effective moduli data are known, then approximations to the collapsing pressure for tubes with L/D less than 1.7 can be made. Table 1 shows that there does not appear to be any greatly significant variation in the effective modulus over a range of t/D ratios. It is also indicated by Table 2 that some variation in effective modulus can be expected with a change in the laminating resin.

Moisture vapor transmission at

(please turn to page 32)

(1) "Collapse by Instability of Thin Cylindrical Shells Under External Pressure" by D. F. Windenburg and C. Trilling, U. S. Experimental Model Basin Report #385.

(2) "A Non-Destructive Method for Detecting the Incipient Buckling Pressures of Thin-Walled Shells", by J. C. New, U. S. Naval Ordnance Laboratory Report No. 1154.

Successful Designing for Plastics Molding

W. M. Holliday

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BEADINGS may be successfully employed to achieve the dual purpose of stiffening the slender walls of a molding, and to improve its external decorative appearance. The article seen in Fig. 1 had to be compression molded in urea or similar thermosetting material, and the original design is shown at A. It consists of a tubular hollow container 'a,' at the upper end of which a cylindrical lip 'b' of short length has to be provided to allow the hollow domed-cover 'c' to be snapped smartly on, a close fit being maintained between the two component parts. The cover 'c' is simply a hollow part carefully molded on the internal diameter to fit on to lip 'b,' whilst the outside diameter of the member is made exactly the same as that of the upper largest portion of the container 'a.' When the cover is in position, the outside diameters of the two portions have to match up exactly and give a smooth, unbroken surface.

The shape is extremely simple and the cavity configurations in the respective molds are easy to reproduce.

Certain undesirable features, however, have to be noticed. In the first place, because of the very thin walls the cover member is slender and easily distorted out of shape. This distortion would be likely to occur during molding, and also when the article is in use. From the point of view of a user, some difficulties would be encountered when removing the cover from the container body on account of the external surfaces being flush with each other. Very poor finger-gripping facilities are present to allow a user to grasp the cover and body comfortably and with necessary pressure.

Despite the pleasing conical curvature on the lower portion of the container body 'a,' and the slightly domed head on the cover 'c,' when these parts are assembled their appearance will be uninteresting. A bad matching of the cover with the container body, moreover, would result from the formation of flashings on these members.

Referring to the cover, the mold would be parted along the line 'x'; that for the container would be parted along line 'y' with the large core plug carried in the movable mold block.

Unless the flashings lying along these lines were carefully removed, instead of a sharp and clean-cut edge on each component to give a close match when fitted together, there would result ragged and snipped edges, giving uneven and unsightly matching.

When removing flash from the cover, no serious objections would be encountered, except that a considerable amount of material may have to be removed from the bottom (open) end face if thick flash were allowed to develop. With the container, however, care would be required to guard against cutting, shearing or otherwise marking the polished, smooth cylindrical surfaces immediately below the lip 'b.'

This projected design A was abandoned in favour of the one shown at B (Fig. 1). Here the cover 'c' is substantially the same shape as before, and it also has the same wall thickness throughout. To increase rigidity and resistance towards distortion, however, two beadings are employed, as shown at 'd' and 'e' respectively.

Beading 'd' is situated at the lower open end of the cover, and is semi-circular in shape (see upper half-sectioned view). The bead extends completely around the diameter and is blended smoothly by means of a small fillet to the domed curvature. On the closed end of the cover, beading 'e' is of very small height and is truly circular, being located concentric with the outside diameter of the part, as shown. In cross-section this beading resembles a cone with a rounded crest.

The presence of beading 'e' considerably increases the rigidity of the wall at the closed end, whilst beading 'd' serves to stiffen up the side walls and allow the cover to retain its true circular shape, even when firmly gripped by the hand.

The container 'f' is similarly modified by the introduction of a beading 'g,' located on the edge of the square shoulder formed between the lip 'b' and the short parallel outside diameter of the part below that lip. The outside diameter of this beading should be slightly less than that of beading 'd,' formed on the bottom end of the cover member, so that the latter bead will actually project beyond beading 'g.' This feature provides a shallow ledge on the cover when fitted in position

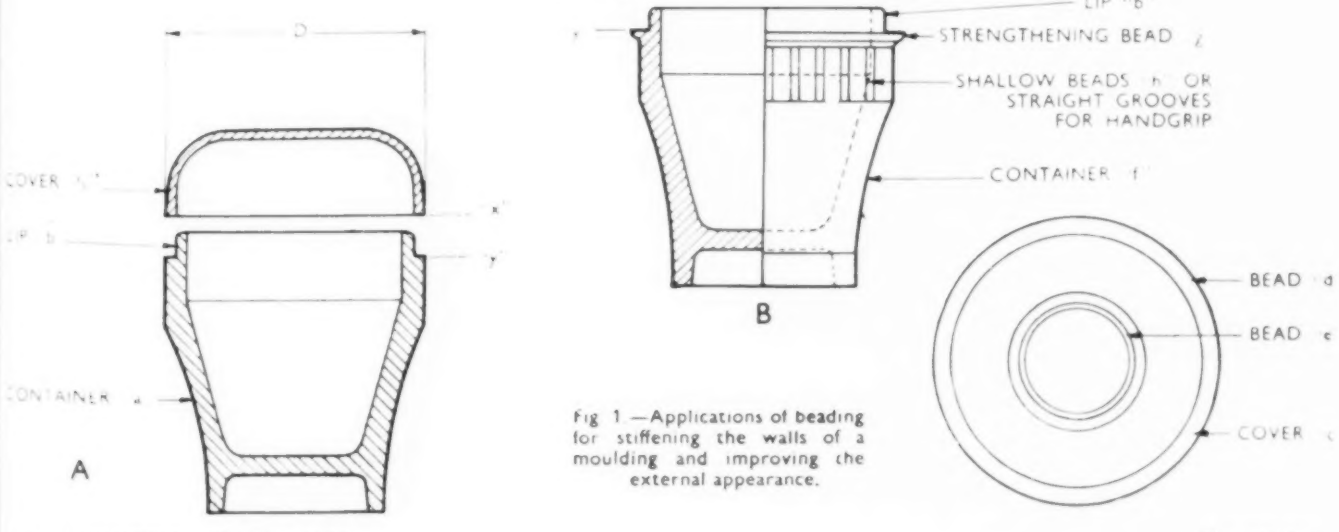

Fig 1.—Applications of beading for stiffening the walls of a moulding and improving the external appearance.

on the container, thus giving simple means for gripping the cover when removing it from the container body. It will also be noted, also, that the cross-section of beading 'g' is approximately quarter-circular, and that this element is blended to the lower parallel portion by means of a small fillet.

Line 'x' denotes the mold parting plane of the tool to produce the cover; it is along this line that any flash would occur. The mold for the container body would have to be parted along line 'y,' situated at the top edge of beading 'g.' Removal of flash along that edge would likewise be relatively simple and safe, in that all risk would be eliminated of cutting or damaging the polished surface of the body below the bead.

The beading 'g' will serve also to increase the rigidity and stiffness of the walls of the container at that open end, which would simplify the ejection of the part from the mold core plug, and later when being handled for trimming.

Still further to improve hand gripping on the container, as also to improve appearance, the short parallel portion immediately underneath beading 'g' is provided with a number of beads, as shown at 'h.' These are located equi-distant all round the cylindrical portion of the body, and are truly axial with the vertical axis of the component, thereby being in line with the normal direction of opening of the mold blocks. They are very shallow, i.e., from .025 to .040 in. in height would be ample, and should be rounded slightly at the crest.

The provision of these raised beadings would be a comparatively simple matter, and would necessitate a series of very shallow grooves into the side of the mold cavity. Negative beadings in the form of shallow grooves could be provided on this exterior portion of the component, and as far as improving appearance and hand gripping these would prove equally as effective as raised beadings. One practical drawback, however, would normally forbid their use, i.e., greatly increased difficulties in forming the walls of the cavity.

To reproduce such grooves would require suitable raised projections on the sides of the cavity, and unless such a cavity could be "hobbed" from a male master plug, a considerably greater amount of machining and setting would be required, since the major portion of the cavity wall would have to be cut back to the required curvature, so as to leave the raised projections for forming the grooves. For this reason, therefore, reverse beadings are not often employed.

Generally, beadings having rounded crests or chamfered edges will be found the simplest to reproduce; they give best results in respect of strengthening the walls of the component, and in adding to appearance. Some designers mistakenly specify perfectly sharp edges and corners when beadings are intended to enhance decorative appearance. Beadings of this type, however, are prone to lose their original shape and clean-cut form much quicker than a rounded design; such knife-edged portions show a tendency to snip and leave rough and jagged edges even in normal handling or usage. Sharp knife-edges are also more difficult to reproduce, due to the fact that some thermo-setting materials have sluggish flow and thus do not penetrate too readily into sharp corners in the mold cavity.

The formation of cavity channels to produce sharp corners and edges on beadings may also present toolmaking difficulties. Not only are such channels difficult to machine, but a greater degree of care will be required when operating the keenly pointed cutting tool required for such purposes. As stiffeners for slender walls, sharp-edged beadings are not so useful, due to the fact that undesirable stress concentrations may be created in the internal structure of the beaded wall by reason of the unduly sudden changes in the direction of flow which sharp corners entail.

Flutes are very similar in shape and form to beadings, except they are usually much smaller. On the other hand, patterns or rows of flutes may be employed on a component surface, whereas the beading is generally used singly. Flutes are applied in connection with some plain unrelieved surface of the component, whilst beadings are located mainly at edges, or external sides of openings, cored holes, and the like.

Fluting

The fluting of surfaces on a molded component is almost exclusively resorted to as a means for increasing the decorative values. This may be accomplished by using them to mask or hide minor surface irregularities and blemishes, such as scratches, "sinks," waviness and flow line patches. Flutes, also, may be adopted to relieve and break large flat surface areas which otherwise would lack interest.

Unlike ribs and beads, which occasionally may be located on an internal surface, flutes are almost always employed on an external surface. When used in conjunction with a rib situated, say, upon some internal surface, externally located flutes may be the means for arresting surface "sinks" and depressions arising from unequal wall section or resultant unequalized shrinkage of the walls.

Fig. 2 shows a good example of a component where external flutings could advantageously be employed. Referring to the example A, which is an unsatisfactory form, it will be seen that the middle portion of this component has to be substantially stepped out, whilst the top surface is perfectly flat and completely uninterrupted by holes, bosses, or other features. The large flat top surface of such a molding would undoubtedly suffer surface blemish by reason of pronounced flow lines, and some waviness. Due to the fact that perfectly sharp corners are provided at all the points in the change of wall directions, considerable stressing would arise, and this in turn would cause the top surface of the part to become buckled or distorted, thus still further diminishing good appearance.

A much-improved form of component design is shown at B, where it will be noted that all sharp corners at the base of the various steps have been eliminated, and in their place the walls have been amply rounded by substantial radius fillets. Thus the sides of the cored-out step on the underside of the part are well tapered back and, unlike the sides of the step in the preceding example, have ample draft to simplify ejection from the mold.

Example A would have strong tendencies to stick on the core, as a result of which the walls of the part may be still further distorted and warped. With example B, instead of the upper surface being formed perfectly flat, a crowned or slightly curved surface is provided. This not

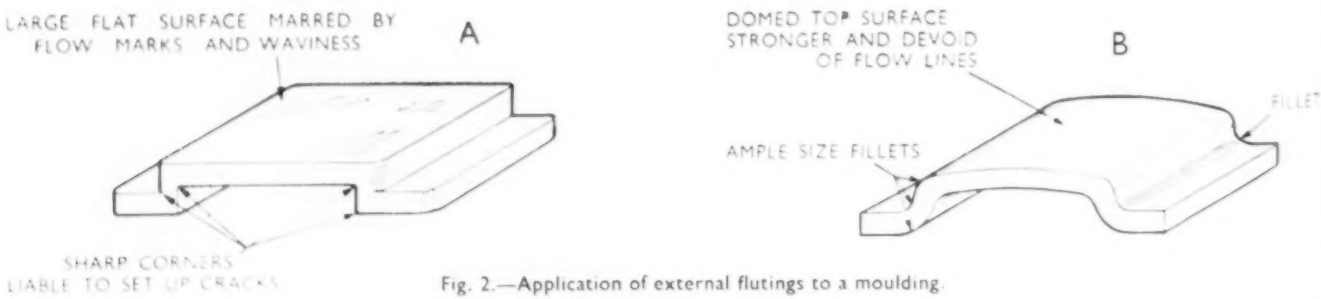
LARGE FLAT SURFACE MARRED BY FLOW MARKS AND WAVINESS
A
SHARP CORNERS LIABLE TO SET UP CRACKS
DOMED TOP SURFACE STRONGER AND DEVOID OF FLOW LINES
B
FILLET
AMPLE SIZE FILLETS

Fig. 2.—Application of external flutings to a moulding.

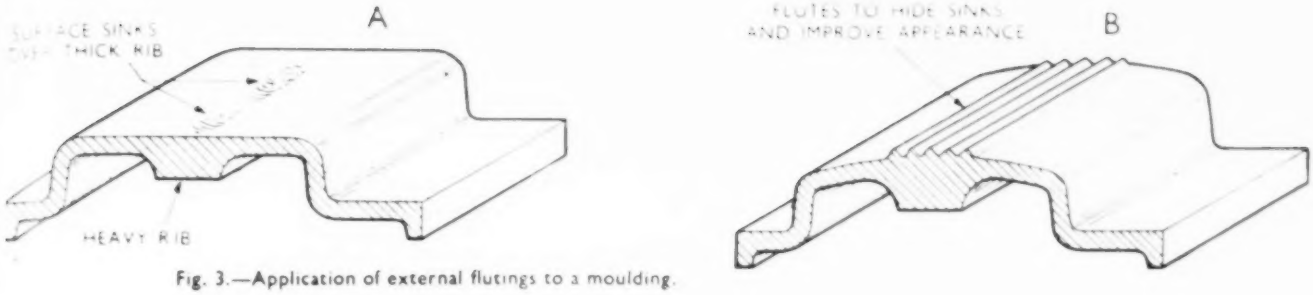

Fig. 3.—Application of external flutings to a moulding.

only improves the surface appearance and light reflecting qualities of the article, but the wall at that point is also strengthened and made more rigid.

Curved surfaces of this kind will be found preferable where large areas are involved, especially when a parting line flash has to traverse across such a surface. Flashings located on such a slightly curved surface may also be removed with greater ease and far less risk of inflicting damage to adjacent smoothly polished molded surfaces, than will be the case when flashings are situated upon large and perfectly flat surfaces.

This type of component is well suited for introducing flutings on the largest flat surface or, alternatively, upon the slightly domed surface. Fig. 3 indicates one simple and effective way in which such an improvement may be effected. The component shown is very similar in design to that depicted at Fig. 2, with the exception that a wide and thick strengthening rib is provided on the underside of the flat-topped wall section in the middle of the cored-out recess or step.

Referring first to A (Fig. 3), a cross-section is given in order to illustrate more clearly the character and location of this rib relative to the top surface of the part. In actual production, certain surface irregularities could be expected. These would mainly consist of "sinks" and depressions, occurring chiefly on the flat upper surface immediately above the heavy rib. Such "sinks" would most probably be distributed well across the width of the component as indicated, and would constitute a serious detraction to the appearance of the finished article.

Such "sinks," etc., would arise from the unequalized contraction forces occurring between the thin-wall sections on each side of the heavy centre ribbed-up portion. The solidification of the thin walls would tend to draw material away from the internal structure of the heavy centre portion, which would remain plastic for the longest time, thereby causing the upper surface to sink slightly to compensate for that drawing-off action.

Diagram B (Fig. 3) illustrates an excellent way in which the above tendencies and surface irregularities may be eliminated or, at least, satisfactorily hidden by the use of flutes running in parallel series across the domed top surface of the molding. The sectioned diagram illustrates the shape of each flute and the most desirable form of "pitching" these members relative to each other.

Each flute is amply tapered on its sides, the height of each element is very small, and the crests are rounded. The flutes are pitched very close together, i.e., approximately twice the maximum width of each flute. The root of the valley formed between each pair of flutes is also rounded to avoid a perfectly sharp corner.

To a certain degree the presence of these five flutes will serve to stiffen the top wall considerably, and in such a manner as to resist the contractional pulls accruing from the shrinkage of the thick rib portion below the flutes. Further, should any surface "sink" occur thereon this would be well masked and far less visible and objectionable than with the previous non-fluted example shown at A.

When flutes are employed in a parallel arrangement of the above kind, small radius fillets of very small height should always be provided where they join the normal wall surface. The valleys between the flutes should be very shallow and well rounded in order to simplify buffing and polishing operations. If sharp corners are allowed at such points, polishing compounds may lodge therein and be difficult to remove. Any compound lodging at the root of flutes is likely to cause discoloration and further disfigurement of the finished article. Articles required for purely decorative purposes, and which have to be cleaned at certain intervals during use, will be maintained at their original high polish and clean-cut impressions on such fluted portions, if sharp corners are avoided.

Flutings of the kind described will be extremely simple and inexpensive to reproduce in the mold cavity formations, and if sharp corners and edges are avoided, the task of polishing and plating the mold will be facilitated. They are often employed either in parallel arrangements or in other geometrical patterns; alternatively, they may follow on irregular line to conform to the shape of the component. Straight lines usually have the best appearance, and are the easiest to produce in the mold cavity.

(To be continued)

Detroit Section Golfing Meets

Emil Gazdick

As we wind up the summer the Detroit Section has had one very successful golf meet in spite of an unforseen circumstance and will hold another in September.

Our golf meet was held in June at the Glen Oaks Country Club and typical, with golf during the day followed by dinner. Our speaker for the evening was Bob Reynolds, Sports Director of Radio Station WJR. His talk embraced the field of sports garnished with colorful remarks about comical incidents in the world of sports.

The unforseen circumstances mentioned above consisted of a terrific thunder and lightning storm that decided to occur about 5 o'clock in the afternoon. In addition to giving some of the golfers a premature shower bath it also caused the lights at the clubhouse to become defunct for the best part of the evening, making necessary the use of candles and lamps to see by. As can be visualized the affair was unique in this respect and especially during the latter part of the evening when the boys sat down to play dealers choice.

There were no fatalities with the exception of the fact that Ray Pope of Kiddie Brush & Toy Company lost a Spaulding Top Flight Golf Club #6720. He believes that in the bedlam that followed the storm he possibly put the club in some one else's golf bag. If anybody has Ray's pet club, please call Bill De Galen to arrange for its return.

The next affair in Detroit will be another golf meet to be held at the Grosse Ile Country Club on September 22nd.

THE *Injection* MOLDERSCOPE

By A. R. Morse

President, Injection Molder's Supply Co.

September, 1953 sees a sudden easing of formerly tight injection machine deliveries. Where 60 days ago, you were airily quoted Spring, 1954 delivery cash before shipment, now its delivery off the floor, no questions asked about your credit, in fact if you have 25% to put down you can get the courtesy of 36 months on the balance!

Such shifts from black to white in the injection machine picture have occurred before of course. I never cease to marvel at the molders' wonder when the salesman comes in and offers him something, where before, he had to dig up cash to get delivery of a press! Almost overnight (around August 15th) molders stopped snatching presses from the manufacturer—phones ceased jangling with urgent pleas for delivery—and uncertainty reigned in the machinery people's plants. Their uncertainty is understandable. You just don't whip up an injection press like a pie. In fact, if you can whip up a batch of 20 presses inside of a year, you are doing pretty well, what with getting all the components together from all the sources, etc., etc. Now that the balance has shifted (as I believe I said it would), I predict the first of the year (the machine programs having been cut back to September's softness) you will begin to find injection machines hard to get. This tightness will probably last up till June, 1954 or possibly later. Now this won't hold true of all makes, as all the managements do not concur on their foresights, but in general, I'll bet you it will.

If you can use an extra press now while the machinery people's sails are hanging limp, it is a good time to get a needed press on your own terms. A little bargaining will pay off, at least as this is written!

LEWIS FORGES AHEAD

When one visits the factory of Lewis Welding and Machine Company and sees the production line on their 4 oz. and their new Hydro-Clamp 6 oz. machines, one realizes that here is a company that is making a real mark in the injection machinery field. As a matter of fact, I was so impressed with the production line on these machines that I asked Bing Miller, their genial and energetic sales manager to take a photograph of it so that the members of SPE could see what Lewis Welding was doing .(See illustration) Just to get the facts on this comparative newcomer to the injection machinery field, I visited the modern Lewis plant and you can rest assured that here is a company that is on their toes and are trying to really do something for the molder.

Production line of 4 and 6 ounce machines at the Lewis Welding and Machine Company

I pointed out to Bing Miller that some of their hydraulic piping was too crowded together and I asked him to take a wrench and fix a pipe which was located inside of several other pipes and he immediately got the idea. I imagine you will see the hydraulic system on these machines greatly simplified and improved as times goes on. You know it is always the inside pipe that breaks—that is the one that is almost impossible to get to.

The new Lewis machines are highly simplified and much improved and I think you can say that Lewis is one of the least hide bound of the machinery people because they are not yet wholly tied down to a costly tooling program which prevents some of the other companies from making improvements when molders suggest that they be made.

No one would deny that an injection machine probably never can be made completely trouble free, but one of the really hopeful signs that means a company is forging to the front is when they admit that the customer is right and try to change the design to accord to the wishes of the user of the machine. I think that Lewis has gone a long way in breaking down some of the die hard traditions of the injection machinery industry where other concerns have allowed changes to lag way behind the time when they should actually have been made, just because business has been so good.

I would not say that the Hydro-Clamp machine is 100% free of bugs yet, but I will say this: that in a short time, it is going to be if Mr. Miller has anything to say about it, and he fortunately does have a great deal to say. Here, again, the Lewis management is to be congratulated because all too often in the past, the injection machine salesman has not had a word to say about the design of the injection machine. When you run into a situation like Lewis Welding where they are **asking for** suggestions and trying to build their machines according to the way the customer wants them, you cannot help but feel the difference. I think it is directly reflected in the remarkable progress Lewis has made in the past 18 months.

And just one closing thought on the Hydro Clamp. Art Jacobs of Berea Plastics and John Muller of Plastic Engineering said recently:—"I have a good idea for a press—use a mechanical toggle for speed and short stroke ($\frac{1}{2}$") hydraulic cylinder for final clamp." Well boys — the Hydro Clamp is just that—and you were by no means the first to suggest this—.In fact, Elno Trump had the idea in 1940 or before, as did Art Schoneberger of Cincinnati, and others, but Lewis were the first to do anything about it.

AROUND THE WORLD

ARGENTINA

PLASTICOS

Vol. 1, No. 2, Oct.-Dec., 1952

Abstracter: John B. Ballard

ARGENTINE CHAMBER OF PLASTICS MOLDERS

Several editorial articles reporting on the activities of this organization of the Argentine plastics industry.

AUSTRALIA

PLASTICS NEWSLETTER

Vol. 3, No. 3, May 1953

Abstracter: Albert Lightbody

ELECTRIC HOT PLATE WITH CAST IN ELEMENTS by F. H. Day

The design and construction of electrically heated platens using Calrod elements cast in iron or Meehanite are discussed.

Vol. 3, No. 4, June 1953

THE PRODUCTION OF STRAIN-FREE INJECTION MOLDINGS

The principal factors affecting residual stresses in injection molded parts are: (1) part design, (2) gating, (3) uniformity of die temperature and (4) symmetry of flow. Injection pressure, actual die temperature and material temperature have little effect on the presence of stresses. Discussion of the factors effecting stresses give possible corrections and optimum practice.

RHOVYL TEXTILE POSSIBLE CURATIVE

According to the newspaper "France Soir," textiles made of the plastic "Rhovyl" have shown some effect in the relief of pain when worn by sufferers from arthritis, rheumatism and lumbago. Tests are now underway in a Paris hospital, using rhovyl sheets and underclothes.

BRAZIL

REVISTA BRASILEIRA DE PLASTICOS

Vol. 1, No. 4, April 1953

Abstracter: Jesse H. Day

REFRIGERATORS IN AN ERA OF PLASTICS, by Murilo Bevilaqua

Plastic materials for use in a refrigerator must be odorless, nontoxic, dimensionally stable, and resistant to moisture. A discussion of the materials and the applications of each, including phenolics, ureas, cellulosics, styrene, acrylics, nylon, and vinyls. Various standard makes of refrigerators are discussed with reference to their uses of plastics.

FRANCE

INDUSTRIE de PLASTIQUES MODERNES

Vol. 5, No. 5, May 1953

Abstracter: Hans Mayer

BATTERIES

Plastics are taking the place of glass, rubber, and other materials formerly used in the manufacture of batteries. The advantages are savings in weight, better resistance to abuses and variations in temperature. All of the following types of plastic have to be used in one place or the other to guarantee a trouble-free battery. Polystyrene, Polystyrene Copolymeres, Modified Styrenes, Rigid Vinylite, Acrylics, and Polyethylenes.

INDESTRUCTABLE ANATOMICAL MODELS

The process used by the Histoslide Co. in making these models from vinyl plastisols is described.

French Production Figures of Plastic Raw Materials for 1952. These figures should be of interest in comparsion to USA statistics:

Cellulosics 3650 tons; Vinyls 12600 tons; Acrylics 550 tons; Phenols 6750 tons; Aminoplastics 4200 tons; phenolic molding compound 7100 tons; aminoplastic molding compound 1460 tons.

A COMPRESSION MOLDED PART A HELPMATE IN INJECTION MOLDING H. Spies

Where parting lines are not permissible to appear on the surface of the molding and a one part steel mold would be subject to breakage due to uneven pressure against an exposed part of the mold, the use of a compression molded thermo-setting insert as part of the mold is suggested. These parts will not stand up in continous use but can be cheaply replaced.

PROGRESS IN DYES FOR PLASTICS—R. Deverell-Smith, B.Sc.

The problems to be faced in the improvement of dyes for plastic materials are easy dispersion, heat resistance, freedom of bleeding, transparency, and light resistance. A discussion of the improvements made by Imperial Chemical Industries in their Polymon materials is made.

ELECTRONIC SEWING MACHINES -II—J. Blond

Following the description of the power unit part of these machines the outside working parts as press mechanism and control as well as the shape and construction of proper electrodes are described.

THE USE OF VINYLIDENE CHLORIDES IN THE ELECTRICAL INDUSTRY—L. Flamache

The characteristics, the manufacture, and the insulation qualities of the material are discussed.

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GERMANY

KUNSTSTOFFE

June 1953

Abstracter: Anne Schwend

A NEW TEST METHOD FOR THE DETERMINATION OF THE DEGREE OF CURE OF PLASTICS MOLDING COMPOUNDS Dr. G. Buettner and R. Lissmann

The principle of this new method is a decided dependence of thermoplastic reaction on the degree of cure. It is characterized by great sensitivity, short test periods, specimen, however, will be destroyed by test. Small square slabs of cured plastic, 1.5 mm in thickness, are put on a metal plate having a round opening in the middle. The test insert is preheated by dipping it into a liquid bath of 140° C. and then put into a pressure chamber filled with non-volatile and non-inflammable heating liquid. Gas pressure will bring the liquid to the desired temperature. Depending on the degree of cure of the specimen, the fluid pressure will cause the slab to bag where the metal insert shows the opening. This deformation is measured with a micrometer. Test results obtained with various kinds of molding compounds of different degree of cure, influence of specimen thickness, test-temperature, test-pressure and the specific weight of molded slabs as well as duration of test are investigated. Comparison with the Vicat testing method and the method for determining the share of elements soluble in acetone is made.

PLASTICS AT THE TECHNICAL FAIR, Hanover

A survey of the variety of new plastics and processed plastics offered at the fair comprises:

Three new types of cast resins offered by Badische Anilin- und Sodafabrik which are tougher and more heat resistant than former types. The same company offers shatter-proof polystyrene (EB) and, among the polyamides, Ultramid S of high dimensional stability upon absorption of water.

A number of differently processed specimen of polytrifluorochloroethylene and dispersions thereof for surface coating offered by Farbenfabriken Bayer. Expanded plastics (Moltopren) were to be seen in elastic form with printing in various colors, in combination with metal using polyester as intermediate layer.

Farbwerke Hoechst's new products consist in resins on the basis of vinyl chloride — vinyl acetate — maleic acid (Hostalit CAM) for lacquering of films and paper.

Chemische Werke Huels offer new plastic dispersions: Lipolit (a copolymer of butadiene and styrene) and PVC dispersions of 61 and 65%.

A new thermosetting molding compound (Bascodur) developed by Badische Anilin — und Sodafabrik and suited particularly for use in chemical apparatuses due to high acid and alkali resistance was shown, differently processed, by various companies as self-supporting machine parts, pump valves, filter presses, etc.

Ciba AG. of Basle introduced a new fluid, cold-curing ethoxylene resin and, for the first time in Germany, melamine powder (Melopas M).

Among the machines exhibited were to be seen:

a. A new hydraulic injection molding machine of 3.3 lbs. molding capacity by Becker & Van Huellen, largest machine offered in Germany.

b. Automatic injection molding machine, oil-hydraulic drive, 5 oz. capacity, high speed closing device, by Ankerwerk Gebr. Goller.

c. High speed injection molding machines of different capacity (Messrs. Battenfeld), incorporating a fully automatic device for preventing renewed injection as long as the molded part has not been ejected. The larger machines work with pre-plasticizers.

d. A self-contained injection molding machine of 350 grams capacity (Dr. Fritz Sommer) which does not depend on accumulators or any other source of pressure reserve.

e. A fully hydraulic self-contained injection molding machine H 100 (Walter Tueckmantel), provided with a new kind of oil pressure pump which makes it possible to supply the unit ready to be hooked to the network.

f. A screw extruder for polyamides (Herm. Berstorff GmbH.), screw diam. 30 mm, which can also be used for blowing of films.

g. Messrs. Paul Troester have equipped their universal extruders with a new oil transmission gear which make infinitely variable speed transmission very smooth.

h. The mixers for powdery, granular and fibrous materials made by Gebr. Loedige Maschinenbau GmbH., built for capacities up to 10,000 litres, work on a new centrifugal and whirling system.

Kunststoffe, July 1953

PLASTICS EXHIBITIONS IN EUROPE

A review of plastics and plastics machinery seen at Oyonnax (France), Milan and Barcelona. Economic aspects and prospects for the countries concerned are discussed.

CREEPAGE FLASH-OVER RESISTANCE AND ARC RESISTANCE Dr. E. Wandeberg

A definition of creepage flash-over resistance and creepage tracks and their causes is followed by a description of the three German test methods proposed for standardization, i.e. the "Nekal Drop System," the "Dip Procedure" and the "Nekal Vapour Method" (see SPE Journal December 1952, page 32). Further details on a method suggested by Messrs. Bisterfeld & Stolting "Initial Spark System" (see same SPE Journal as before), the D 495-48 T" ASTM Standard and an arc resistance method working with low voltage melting of the specimen between two electrodes, are given. In the author's opinion the three best methods would be the Nekal vapour, initial spark and ASTM arc resistance methods. It is hoped that after extensive investigation and comparison of the proposed systems it will be feasible to standardize only one or at the maximum two methods, especially those that will reduce the testing period to a minimum.

INJECTION MOLDS FOR THERMOPLASTICS G. Thilenius

A survey of the manifold forms of injection molds, particularly as built by Eckert & Ziegler of Weissenburg. This company soon recognized the cost- and time-saving necessity to build master molds in various sizes allowing the exchange of inserts or in some instances only parts of inserts. Several sets of inserts are used for molded-in metal parts so that one set may be removed after injection and refilled with metal parts. Utilisation of slides, slide draw pins, threefold split conical bushings for molding dial switches, etc., split rings, ejector pins, trimming and unscrewing devices, number of cavities, proper venting, cooling and heating are discussed.

TESTING APPARATUS FOR RESINS DURING HEATING Dr. Walter Toeldte

A new apparatus developed by the material testing institute of Berlin, for determining characteristic temperatures of the different stages during the melting process of resins. It consists of a tube with round bottom which carries a side-arm through which a narrower tube holding the material to be tested is inserted. The bath liquid is kept in motion by an electrically driven stirrer while heating the tube. This method does not only permit visual observation of the melting process, but flow and setting properties of the material can also be tested by touching with a glass rod. Decomposition of the material

can be observed with a piece of litmus paper in the side-arm of the tube and watching the temperature at which acid or alkaline decomposition products form.

BASIC PRINCIPLES OF THE INJECTION MOLDING PROCESS

Abstracts from SPE Journal, February 1953.

EPICHLOROHYDRIN RESINS Dr. J. Schrade

A survey on literature dealing with the production of epichlorohydrin resins, production process for thermoplastic epoxy resins and the possibilities to transfer same into unmeltable polyplastics. Several methods for the determination of the contents of ethylene oxide groups in resins are cited.

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GREAT BRITAIN

PLASTICS,
May 1953

Abstracter: Alfred T. Rexer

PROGRESS IN EXTRUSION

A three page article with illustrations gives a brief description of the development of extruded plastics for new industrial purposes.

THE EFFECT OF HIGH ENERGY RADIATION ON SOME LONG-CHAIN POLYMERS by Dr. A. Charlesby

A four page article with charts and illustrations deals with the effects of high energy radiation on the properties of certain plastic materials as determined during a programme of research now being carried on by the Atomic Energy Research Establishment at Harwell.

TECHNIQUES OF MOLDING POLYTRIFLUOROCHLOROETHYLENE by C. R. Giannotta

A reproduction of an article published in the SPE Journal.

THE BRITISH PLASTICS EXHIBITION AND CONVENTION, 1953

A special supplement gives information as to the structure and scope of the British Plastics Exhibition being held in June.

POLYESTERS — SOME NOTES ON THEIR BASIC CHEMISTRY by J. Rhys

A short article explains the fundamental chemistry of polyester resins. It also traces the history and touches upon some present applications.

NYLON MOLDINGS by E. E. Halls

The general properties of nylon in molded form are reviewed. Notes are given on such points as chemical resistance, water absorption, electrical properties, and mechanical strength. Results of tests are recorded in tabular form.

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SPAIN

REVISTA de PLASTICOS

Vol. 4, No. 21, May-June 1953

Abstracter: John B. Ballard

THE DEVELOPMENT OF THE GERMAN PLASTICS INDUSTRY SINCE 1945—Dr. Suhle

A review of recent developments in German, by the Secretary-General of the German Plastics Industry Association.

HERMETICALLY SEALED PLASTIC CONTAINERS

An editorial or publicity release describing a process and equipment for sealing plastic containers for foods, medicines, etc., patented by Arthur Spielmann of Frankfurt, Germany.

IMS NYLON ANNEALING TANK

STABILIZE NYLON PARTS against dimensional changes. New IMS Nylon Annealing Tank protects . . . hardens . . . ages . . . toughens . . . relieves strains . . . in costly nylon molded parts.

Bench Models and Floor Models available. Equipped with long-handled baskets of heavy duty steel mesh.

Safe — Easy to Operate

Designed for use with Hitec heat transfer salt. Side heated for safety, thermostatically controlled.
Range from 200° to 500°.

PRICES:

Floor Model (with stand and bottom drain for salt removal)
5 gal. salt capac. Tank size 13½" x 8⅝" — $196.00
10 gal. salt capac. Tank size 13½" x 16¾" — 261.00
25 gal. salt capac. Tank size 18½" x 22" — 464.00

Specify if for 110 or 220 volt single phase operation.

INJECTION MOLDERS SUPPLY CO.
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THERMOLATOR*

Portable (illustrated) models, and fully automatic models with remote panel-mounted controls with operating range up to 250° F. First, and Finest!

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Industrial MFG. CORP.
Specialists in Industrial Heat Transfer by Liquids
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SPANISH PLASTICS CENTER

An editorial reporting the establishment of the new Spanish Plastics Center, an organization with headquarters in Barcelona which aims to promote the best interests of the entire Spanish plastics industry.

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SWEDEN

SVENSKA PLAST FORENINGEN TEKNISKA MEDDELANDEN

February 1953

Abstracter: Walter E. Werber

THE STABILIZATION OF VINYL RESINS by H. Verity Smith, B.Sc.

This article deals with the stabilization of various types of vinyl resins. It contains American patent literature on the subject and contains detailed formulas on the reaction of various stabilization agents on vinyl resins.

RIGID PVC by Gunnar Sundblad, and Hans Rudberg

Rigid PVC applications and fabrication methods from a lecture at the Swedish Plastic Association on 27th & 28th of November 1952.

A survey is made of the thermal properties of rigid PVC and the forms in which it is supplied for fabricating. Fabricating methods are discussed, such as turning, milling and boring. Various heat forming methods for rigid PVC are discussed and the methods of bending and joining of tubing is dealt with. The welding of rigid PVC is discussed in detail and methods are described for it. The article ends with pointers regarding the use of adhesives for the joining of rigid PVC parts.

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UNITED STATES

Abstracter: J. J. Lamb

TABLES OF DIELECTRIC MATERIALS, VOLUME IV, A. von Hippel, Tech. Rep. No. 57, Lab. for Insulation Research, Mass. Inst. Tech. Jan. 1953, 138 pages.

A very complete list of dielectric constants and tangents of loss angle. For many materials there are data for each decade of frequency up to 10,000,000,000. This volume contains the more important data from the previous volumes and data on 250 new materials. About 40 pages are devoted to commercial plastics, with each material identified with the manufacturer's code number and, sometimes, the composition. Phenolic molding compounds and laminates, silicones, fluorocarbons, polyesters, styrene copolymers, rubbers, epoxys, vinyls, cellulosics, ceramics, glasses, oils, steak (bottom round), and Ivory soap are included. The two indexes, of materials and manufacturers, are complete.

FATIGUE TESTS OF GLASS-FABRIC-BASE LAMINATES SUBJECTED TO AXIAL LOADING, by K. H. Bohler, Forest Products Lab. Report No. 1823, May 1952, 66 pages.

Tension—compression fatigue tests of three ¼-inch thick laminates (181-114 and 143-114 cloths and two polyester resins) were made at 75F on wet, dry, notched, and unnotched specimens. A total of 19 combinations of test conditions were used, including mean stresses of 20 and 50 percent of the ultimate tensile strengths.

The static tests of the laminates met USAF specifications 12049 and 12051. Fatigue strengths at 10,000,000 cyles were between 22 and 29 percent of the tensile strength. With a mean tensile stress of 10,000 psi, the stress amplitude must be less than 2,000 psi for a 10,000,000 cycle test. Notches decreased the fatigue strength about 20 percent and water did not affect the 10,000,000 cycle fatigue strength, but it was effective at less cycles. Semi-logarithmic S-N curves were still decreasing at 10,000,000 cycles, except that for tests at 45 degrees to the warp the curve was nearly horizontal above 100,000 cycles.

This is indispensable information on currently-produced laminates.

Plastic Tubing

(continued from page 24)

high external hydrostatic pressures is of definite concern in the use of plastic tubing for naval ordnance purposes. It is desired to have the lowest possible transmission rate so that, over a long period of exposure to hydrostatic pressure, the amount of water seepage will not adversely effect mechanisms contained within a plastic structure. Laboratory evaluation of phenolic-glass cloth tubes at 300 psi water pressure has given a transmission rate of approximately 0.0004 grams per 24 hours per square inch of exposed surface. This value was determined on a specimen of ¾" wall thickness having an approximate diameter of 20" and a length of 40". With a polyester-glass cloth tube a water transmission rate of approximately 0.0009 grams per 24 hours per square inch of exposed surface has been established at a 300 psi pressure. The polyester specimen had a ¼" wall, was 12" long and had a 6" inside diameter. These values were determined by successive weighings of desiccant bags placed inside the specimens. Periods of the tests ran from 3 weeks to 3 months. To reduce this inherent porosity of laminate materials, it has been found possible to incorporate aluminum foil in the structure. Care must be taken to properly clean the foil in the same manner as used in preparing aluminum surfaces for adhesive bonding. It is also necessary to select the resins carefully as their bonding efficiencies vary greatly.

Table 1
Variation of Effective Modulus of Elasticity With Thickness-to-Diameter Ratio

t D	Effective Modulus psi x 10^{-6}
0.0285	3.30
0.0231	3.12
0.0167	2.68
0.0093	3.85

L D = 2.9, Resin D, 181-114 glass cloth

Table 2
Variation of Effective Modulus of Elasticity With Resin

Resin	Effective Modulus psi x 10^{-6}
A	4.28
B	4.14
C	4.33
D	3.30

L D = 2.9, t D = 0.0285, 181-114 glass cloth

The Naval Ordnance Laboratory has found it possible to produce quality tubing which fullfill its specialized requirements. And with some modifications, the method of manufacture can be adopted to large scale production.

This article is based on a talk given for the SPI Reinforced Plastics Division, in Chicago, April, 1952.

Editor's Desk

(continued from page 5)

their ability to use what they have learned, rather than specific knowledge in our particular area.

Very truly yours,
George C. Hoffman
Supervisor of Technical Employment

WELCOME
PITTSBURGH
Section of SPE

SECTION NEWS

Edited by

Stanley Bindman

Jamison Plastic Corp.
71 E. Sunrise Highway
Freeport, New York

Blends of Plastics with Rubbers to Be Joint Forum of Cleveland-Akron Section With The Akron Rubber Group

Frank A. Martin

Last fall the Cleveland-Akron Section of SPE in cooperation with the Akron Rubber Group held a joint symposium on Vinyl Compounding and Processing. The response to that meeting was so gratifying that the two groups are again combining forces to arrange another symposium on another subject of interest to both the plastics and rubber industry.

On Friday, October 23, at the Mayflower Hotel in Akron a panel will present a discussion on "Blends of Plastic Resins with Rubbers." This discussion will be held in the main ballroom at 2:00 P.M. with dinner and a good after-dinner speaker to follow.

The symposium panel will consist of Dr. Fred Stavely, Firestone Tire & Rubber Company, who will act as moderator. The panel specialists and their subjects will be: R. C. Holt, Marbon Corporation who will discuss "Blends of Styrene—Butadiene Resins with Rubbers—Rigid Compounds;" H. S. Sell of Goodyear on "Blends of Styrene-Butadiene Resins with Rubbers—Non-Rigid Compounds;" W. D. Crater of Naugatuck Chemical on "Blends of Styrene-Acrylonitrile Resins with Rubbers." Other panel members are R. C. Bascom of Goodrich Chemical discussing "Blends of Phenolic Resins with Rubbers;" W. J. Smith of Firestone speaking on "Blends of PVC with Rubbers;" and Dr. A. J. Urbanic of General Tire and Rubber who will summarize the field under the title "Other Blends—Present and Future."

The program will consist of a short talk on each subject followed by a question and answer period. Questions are solicited in advance, and may be sent to any of the committee members or to Dr. Stavely.

Arrangements for this meeting are in the hands of a special joint committee headed by Frank Steere and Z. N. Harris. Other committee members are Harold Catt, Hugh Winn, Dave Sloane, and Frank Martin.

Plastics Decoration Topic At Upper Midwest

A. D. Sinning

Approximately 50 members and guests from the Twin Cities area are expected to attend the September dinner meeting at the Andrews Hotel on Monday, September 21, 1953. They will hear Mr. McArthur, of Conforming Matrix Corporation discuss the decoration of plastics. A film and exhibit will accompany the talk and questions will be answered from the floor following the program.

The annual June outing this year was well attended and featured a trip to one of the U.S.A.F. radar detection stations in this area. There members and their wives were shown the methods for location and identification of aircraft, within the range of the instruments. Of special interest to plastics engineers were the varied applications of numerous plastic materials in physical and electronic components of this installation — many of them quite out of the ordinary.

Newark Section to Meet October Fourteenth

Newark will meet October 14 to hear Thomas Harris of American Airlines speak on "Potential Market for Plastics."

Art Warner of Federal Telecommunication Labs. has been transferred to London this September.

New York Plans Vocational High School Plastics Course

Arthur M. Merrill

An intensive program carried on by the New York Section, Society of Plastics Engineers, Inc., during the past year has culminated in the establishment of a specialized course in plastics this September at the Machine and Metal Trades Vocational High School in New York City. The course, open to selected senior year students, will cover the manufacture of plastics, including raw materials, injection, extrusion, and other methods of molding, and fabrication.

The Section cooperated with the New York City Board of Education to organize the course and prepare the curriculum. This work was conducted by the Plastics Education Commission of the Advisory Board for Vocational and Extension Education. Harold Schwartz, chief of the plastics division, Empire Brushes, Inc., and vice-president of the New York Section, SPE, is chairman of the Commission, and is assisted by Richard M. Thews, Monsanto Chemical Co.

During the past school year, the Commission's special publicity committee conducted plastics information forums for the guidance counselors and students of the City's elementary and junior high schools. Leading this committee were Herbert J. Weber, Rotuba Extruders, Inc., and William Lewi, Dusal Tool & Mold Co., Inc.

The New York Section has conducted an extensive survey of the plastics industry in the Greater New York area to show the enormity of the industry and the excellent employment possibilities for vocational course graduates. The Section has gathered equipment valued at over $5,000 for the course, installed the equipment, and is gathering funds for maintaining and adding further equipment. Bruno E. Wessinger, Wess Plastic Molds, Inc., is in charge of equipment and installation, and the fund raising program is headed by G. Palmer Humphrey, R. C. Molding, Inc.

The course is expected to be the forerunner of the first plastics vocational high school in New York City.

Connecticut

Connecticut met September 18th at The Hotel Barnum to hear David Mersey speak on "The Plastics Industry in Connecticut—A Survey."

Tinkham Resigns

Sumner E. Tinkham has announced his resignation as Executive Engineer at Shaw Insulator Company. Plans for the future have not been announced.

Forum on Education

(continued from page 21)

I think you will all agree with me that Dr. Bartlett's survey shows that many of the companies polled would like to have engineers with various undergraduate specialties who have been put through a common post-graduate program in plastics. In our program we propose two introductory undergraduate courses and five graduate courses. In each case the emphasis is on broad fundamentals rather than on specific "know how" or proceedure. In many cases the course material is of such a fundamental nature that is can be applied to nearly all engineering materials whether of polymeric nature or not. For example the subject of rheology as it would be presented in the Properties of Plastics course is of such a fundamental nature that it is equally applicable to many industries. This same subject when properly presented from the point of view of fundamentals is of value to nearly all the many facets of the plastics industry, to name a few; properties of plastics under fabricating conditions, fundamentals in equipment design, processing problems in production of materials, and of course the well known problems in surface coatings and adhesives.

It has been suggested that colleges and universities should teach only the fundamentals of science and leave all specialization to on-the-job-training. This sounds very good in principle but neglects some of the facts. First of all students need some experience and training in the class-room to show them how to apply their knowledge of fundamental science to the problems of various industries. Secondly our technology has progressed to the state where the fundamental concepts involved in specific industries are so advanced that they are very difficult to grasp without formal training. It is our belief that it is a more efficient process to convey these principles to our young engineer in a class-room rather than making him dig them out by himself when he is on the job. For example, since plastics are used as engineering materials in the electrical insulating field, it is apparent that the producers in this business must have men who can determine the properties of these materials. I am sure you all appreciate how much time and effort would be required for, let us say, an electrical engineer to make himself an expert in this field by on the job study.

Your National Office

(continued from page 8)

this column in the November issue of the **Journal.**

By way of preview, a membership campaign is underway shooting for a total membership of 5000 in twelve months. Can we count on your support?

P. L. Underwood

Executive Secretary

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Printed Circuits

(continued from page 12)

cal strength and conventional wiring difficulties.

Q. Which plastic metal clad materials are best suited for solder-dip methods?

A. Since Synthane does not manufacture any of the extreme high temperature materials such as silicone or Teflon our results are only with phenolic or melamine laminates. This question is more or less answered above with Mr. Babbe's questions but, generally speaking, we have found XXXP-IR with our Synthane bond to be very satisfactory for dip soldering. Minimum and conservative results are 425°F for 10 seconds in molten solder without blistering and, as above stated, longer periods at lower temperatures are common.

Q. What requirements and what difficulties have been encountered in the punching of metal clad materials?

A. Materials up to 1/16" in practically all grades can be fabricated with Blanking and Piercing dies—minimum hole diameter to be greater than thickness of material—Grade XP, L.E., and C.E., glass melamines, glass silicones and Teflon etc., in the thicker materials lend themselves to punching.

Q. Since the laminator's problem is to furnish materials rapidly, inventory is important. Therefore, what thicknesses and types of base material do you think will be the most desired?

A. With the major portion of printed circuitry being performed on flat sheets, the base thickness in most cases will gengrally vary from 1/32 to 1/8 inch. The types of base material, with the same consideration of flat sheet circuits, may be anticipated to be of the same general characteristic. Machinability, moisture resistance, and terminal mounting shall dictate the types used in most cases, while arc resistance, dielectric strength, and temperature resistance should define the remaining types used. In the first case grade LE should replace grade L, and in certain applications XX or XXXP-IR may be used. In the second case glass melamine or arc resistance material should normally be used.

Q. Which plastic metal clad materials are satisfactory for post-forming?

A. Foil laminates have been made using regular post-forming materials, both paper base and fabric base materials. Generally speaking, this is a difficult operation since the temperatures in post-forming application may be critical for the bond. An excellent method has been to use a copper foil laminate as thin as possible, for example from .006" to .012" thick, and etch the circuit or design and then secure it to the post-formed base by means of a good adhesive. This eliminates the difficulties of etching on to a curved surface.

Q. What is the engineer's opinion as to the "flushing in" of circuits and patterns?

A. This question may be readily answered by considering the factor of cost. If the specific application warrants the use of flushing, it would be desirable. If not, there is reason to believe that normal surface etching would be most satisfactory. However, flushing in has its distinct advantages for rotational and moving part applications in electronics, optics, and many other cases.

Q. In flush-surfacing, what is the best metal surface finish and which plastics should be used?

A. Metal surface finishes may be silver, rhodium, or chrome. Rhodium is recommended as superior for resistance to wear and best electrical qualities. Most plastics 1/8" thickness and up, other than nylon base materials lend themselves to flushing in—although thinner materials have been processed but offer more problems.

Q. What method have you developed in the acid wash to reduce the undercut?

A. Unfortunately in the use of acids for etching the action is in all directions. Therefore we have devised a process incorporating electro etching and a specially designed machine that pressure feeds acid with a directed force to the part, plus a critical timing control, we feel we have gained the minimum of undercutting.

Q. It is recognized in many applications that warpage of materials is critical—specifically in the manufacture of commutators, code discs and switch plates. Is it possible to manufacture a material that will conform to the above qualifications in thicknesses from 1/32" and up? What type of base material would be best?

A. Warpage has always been a problem of varying degree with nearly all types of phenolic laminates. This is especially true with metal clad laminates and doubly so where one side of copper only is used and where very thin plastic is used the warpage is more noticeable. Generally speaking, where metal is combined with phenolic the different coefficients of expansion will result in warpage even where a flat base phenolic would normally exist. It has been found that usually the degree of warpage is greatly reduced after the etching process has been finished.

As to the types of material that will have the least warpage, thicknesses of 3/32" and up are best. It has been our experience that our Grade XXXP-IR is the best material for flatness. However, we must admit, warpage is still a problem.

Q. Would you agree that engineers who postpone or show lack of interest in the conversion of their product to the usage of etched circuitry, may find their product out moded?

A. Not only will they find their product out moded, but they will find that they will need to redesign in certain cases to cope with competitive costs. In the ever expanding field of miniaturization and electronic assembly where identical parts are being fabricated there is a need for simplification and reduction of hand labor. Printed circuitry is a means of producing more at less cost and should be used to its best advantage wherever possible.

Retailer's View of Plastics

(continued from page 14)

to eliminate substandard products regardless of the plastic from which they are made and therefore should be developed and supported by the plastics industry.

In conclusion, it is not only fitting and proper for me to say that I trust my remarks are accepted as being given in a constructive vein to the end that the plastics industry will continue to do an even better job in the future than it has during its relatively short and I might add—most beneficial and illustrious existence.

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Dear Friends:

Jerry told you last month that I would mention some reinforced plastics work this month. Did you ever contemplate how long it would take to drill 22,500 holes? Well, these 22,500 holes go in 560 parts for an average of 40 holes per part. That average of 40 doesn't mean much and I'm sure the Government would not accept any piece that had 40 holes in it. Some have 8 and some have as high as 220 holes. Some of the statistics passed out mean about as much as the 40 average I mentioned. For example, how would you like to live where the average temperature is 70° F. (-20° to +120°)?

This little dissertation on averages doesn't have much to do with mold design. However, we do think our batting average is pretty high. It certainly is pleasant to have someone call and say "We've got a tough mold design job and we want you folks to do it"

Yours for Better Living with Plastics

Wayne I. Pribble